

EOI Document**for**

**[DESIGN, ENGINEERING, SUPPLY, CONSTRUCTION, TESTING,
COMMISSIONING INCLUDING OPERATION AND MAINTENANCE OF
20MW MUSCAT INTERNATIONAL AIRPORT & 6MW (SALALAH
AIRPORT SOLAR PV PROJECTS ON ASSET LEASE BASIS FOR FIXED
TENURE]**

EOI No: TCIL/45/Oman/2023-24/ Solar- Oman Airports**Date of Issue: 09/10/2023**Issued By:**[TCIL Oman]**

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SECTION-1

EXPRESSION OF INTEREST (EOI)

EOIs are invited from all eligible bidders for Pre-Tender Tie-up with TCIL for “**DESIGN, ENGINEERING, SUPPLY, CONSTRUCTION, TESTING, COMMISSIONING INCLUDING OPERATION AND MAINTENANCE OF 20MW MUSCAT INTERNATIONAL AIRPORT & 6MW (SALALAH AIRPORT SOLAR PV PROJECTS ON ASSET LEASE BASIS FOR FIXED TENURE in Oman**” for a reputed Client in Oman.

Telecommunications Consultants India Ltd. (TCIL) is a Govt. of India Enterprise, under Department of Telecommunications, Ministry of Communications. It was set up in 1978 to share Indian experience and expertise with developing countries and to assist bulk users of telecom services in setting up dedicated telecom networks.

TCIL has been undertaking various projects in all fields of telecommunications and information technology and also continuously deploying new technologies in the field of Telecom Software, Switching and Transmission Systems, Cellular Services, Rural Telecommunications, Optical Fiber based Backbone Transmission Systems etc. TCIL has diversified its operation and has been executing projects in the field of Civil Infrastructure, Architecture and Power, Rural Roads and Civil Construction. TCIL has been executing projects in latest technologies like FTTH, VOIP, IPTV etc.

TCIL Oman was established in 1986 doing contracting works to provide Infrastructure development for GTO (General Telecommunications of Oman) which was later on called as Omantel. The activities were providing Telephone services to the subscribers by laying of copper cables to the subscribers by means of excavation and at later stage, new technology of fiber optic cables was introduced by TCIL for the Oman’s corporate world and the other subscribers. Fiber optic cables were also installed. Since 1986 TCIL has executed value of works worth Omani Rial 35.00 Million with various clients viz Oman Broadband Company, Omantel, PDO, OCIC, SSB, MOD, and Ooredoo etc. TCIL still continues to support either directly to Oman Broadband Company and indirectly to Omantel and other Telecom Operators/ Infrastructure Providers in Telecom Network development.

TCIL intends to participate in this tender as main bidder for “**DESIGN, ENGINEERING, SUPPLY, CONSTRUCTION, TESTING, COMMISSIONING INCLUDING OPERATION AND MAINTENANCE OF 20MW MUSCAT INTERNATIONAL AIRPORT & 6MW (SALALAH AIRPORT SOLAR PV PROJECTS ON ASSET LEASE BASIS FOR FIXED TENUREin Oman**”. This EOI is floated for selection of back end partner ready to work in the above project for TCIL on exclusive basis and back-to-back basis.

Submission of Online Bids is mandatory for this EOI. Prospective bidders need to submit their bids with the most competitive Techno-commercial offer for the aforesaid work. EOI document is available on TCIL website (<https://www.tcil.net.in/nit.php>) & GePNIC portal (www.etenders.gov.in). The important dates are as given below:-

1.1 IMPORTANT DATES

Date of Posting of EOI:	09/10/2023
Start Date of downloading/viewing EOI:	09/10/2023
Last date & time for seeking clarification, if any:	13/10/2023, 10.00 Hrs
Start date & time for Online submission of Bids:	09/10/2023, 10.00 Hrs
Last date & time for Online submission of Bids:	16/10/2023, 10.00 Hrs
Opening of Technical Bid (Part-I):	16/09/2023, 11.00 Hrs
Opening of Financial Bid (Part-II):	16/09/2023, 11.00 Hrs

Bids shall be submitted on GePNIC Portal (<http://etenders.gov.in>). Bidders are advised to visit GePNIC portal (<http://etenders.gov.in>) and/or TCIL website regularly for updates/amendments, if any. Bidders can contact NIC for

Telephonic Help Support on Toll Free Help Desk Number- 1800 3070 2232 for requisite queries regarding registration, training, demonstration, minimum system requirements etc. of Government e-Procurement System of NIC (GePNIC).

1.2 **ELIGIBILITY CRITERIA**

- a) As per SOW (enclosed as a separate attachment)
- b) The bidder should not be insolvent, in receivership, bankrupt or being wound up, not have had their business activities suspended and not be the subject of legal proceedings for any of the foregoing. An undertaking by the bidder should be submitted.
- c) The Bidder should not be blacklisted/debarred/banned/restricted by any Union Govt./State Govt. /PSU as on date of submission of the Bid. "No-Conviction Certificate" duly signed by authorized signatory signing the bid, should be submitted in the prescribed format.
- d) The bidder needs to submit an Undertaking stating that: Vendors, whose Purchase Order(s) for any Project of TCIL was/were cancelled on risk & cost basis for non-performance or non-submission of performance guarantee in last 5 years, are not eligible to participate in this tender.
- e) The bidder shall fulfill the following financial criteria:-
 - i. Average Annual Financial Turnover during the last 3 financial years, ending 31st March of the previous financial year should be at least 30% (25% for Micro and Small Enterprises (MSEs) & Startups) of the estimated cost of purchase (excluding GST).
 - ii. Net worth should be positive as on 31st March of last Financial Year.
 - iii. The bidder should be in profit before tax (PBT) in two out of last three financial years.
- f) Experience of having successfully completed similar works/supplies during the last 7 years from the date of bid submission should be either of the following:-
 - A) Experience Criteria for IT/ Telecom project :-
 - a. For projects with estimated/ expected completion period less than or equal to 1 year:-

Two similar works each costing not less than 30% (25% for MSEs & Startups) of the estimated cost (excluding taxes), in last 7 years.

OR

One similar work costing not less than 40% (35% for MSEs & Startups) of the estimated cost (excluding taxes), in last 7 years.
 - b. For projects with estimated/ expected completion period of more than 1 year:-

Two similar works each costing not less than 30% (25% for MSEs & Startups) of the estimated cost (excluding taxes), in last 7 years.

OR

One similar work costing not less than 50% (45% for MSEs & Startups) of the estimated cost (excluding taxes), in last 7 years.
- g) Bid by Consortium is not allowed
- h) **Manufacturers Authorization Certificate (MAF), If applicable**

The bidder should submit Manufacturers Authorization Certificate (MAF) from Original Equipment Manufacturers

(OEMs) specific to the bid for items mentioned in this EOI.

In case of unavailability of MAF at the time of EOI response, bidder should submit an undertaking stating that the same shall be submitted before opening of Financial bid.

- 1.3** The bidder should give an undertaking on the company's letter head that all the documents/certificates/information submitted by them against this EOI are genuine.

In case any of the documents/certificates/information submitted by the bidder is found to be false or forged, TCIL shall immediately reject the bid of such bidder(s) or cancel/terminate the contract and forfeit bid security / Performance Security submitted by the bidder and debar them from participation in future EOIs/tenders of TCIL for a period upto 5 years.

- 1.4** A statement showing **Clause-by-Clause compliance to all Terms & Conditions** of all the Sections of this EOI and as well as end client's, if required, duly Signed and Stamped on the Letter Head of their Organization. The bidder shall submit No-Deviation Certificate along with above.

Bidder shall submit technical data sheet by highlighting each complied specification. Wherever technical specifications and operational/functional requirements not mentioned in datasheet, OEM compliance shall be submitted.

- 1.5** **The Client's tender** and its amendments forms an integral part of this EOI.

1.6 **BID SECURITY (EARNEST MONEY DEPOSIT)**

Deleted

1.7 **TENDER FEES**

NIL

1.8 **EVALUATION**

- a) TCIL shall evaluate bids in respect to substantive responsiveness of the bid or otherwise. TCIL shall carry out detailed evaluation of the substantially responsive bids only.
- b) A bid determined as substantially non-responsive technically/financially shall be rejected, even after opening the price bid.
- c) TCIL may waive any minor infirmity or non-conformity or irregularity in the bid which does not constitute a material deviation.
- d) Among all technically qualified bids, the lowest bid will be termed as L1 (including all taxes) derived from Price Bid Schedule.
- e) If there is a discrepancy between the unit price and total price that is obtained multiplying the unit price and quantity, the unit price shall prevail and the total price shall be corrected.
- f) **NPV BASED EVALUATION CRITERIA: IF APPLICABLE**
 - (i) Applicable for works/tenders where scope of work includes CAPEX and OPEX (O&M/AMC) or only OPEX, where OPEX activity is spread over a period of two or more years.
 - (ii) Bids shall be evaluated on the basis of the lowest NPV (Net Present Value) without taxes.
 - (iii) Total cost shall be CAPEX+NPV of O&M/ AMC.
 - (iv) The discounting rate of 10% per annum shall be used for calculating NPV.

1.9 VALIDITY PERIOD OF BID

The Proposals must remain valid for a minimum 90 days from the last date of bid submission to end Client. In exceptional circumstances, TCIL may request the bidder for an extension to the period of bid validity if same is extended by end client and accordingly, the bid security shall also be suitably extended by the bidder.

1.10 IP PROGRAMME :

Deleted

1.11 INTEGRITY PACT [applicable for value of project above 5 Cr]

- a) This EOI is covered under Integrity Pact Programme of TCIL and bidders are required to sign the Integrity Pact Document and submit same to TCIL before or along with the bids.
- b) Integrity Pact Agreement duly signed and stamped by Authorized Signatory & Witnesses has to be submitted in physical form at the time of bid submission. In case of consortium bid, the lead partner shall sign as authorized signatory and the consortium partner as witness.
- c) EOI received without signed copy of the Integrity Pact document will be liable to be rejected.
- d) In case of Joint Venture, all partners of the joint venture should sign the Integrity Pact. In case of sub-contracting, the Principal Contractor shall take the responsibility of the adoption of IP by sub-contractor. It is to be ensured that all sub-contractors also sign the IP.

e) Mediation Clause

In the event of any dispute between management and the contractor relating to those contracts where integrity pact is applicable, in case, both the parties are agreeable, the dispute may be settled through mediation before the panel of IEMs in a time bound manner. If required, the organizations may adopt any mediation rules for this purpose.

In case the dispute remains unresolved even after mediation by panel of IEMs, the organization may take further action as per terms and conditions of the contract.

1.12 SIGNING OF NON-DISCLOSURE AGREEMENT

This RFQ and all materials submitted by Client must be considered confidential. It must not be forwarded to any third party for evaluation or for any other purpose without the written consent of Client. When submitting confidential material to Client, the Bidder must clearly mark it.

This RFP and Client process of evaluating sourcing opportunities, as well as the timing and content of any meetings, discussions and negotiations between Client and the Bidder, will be deemed 'Confidential Information' for the purposes of the Non-Disclosure Agreement (NDA).

Bidders must recognize and acknowledge that Client operates in a highly competitive business environment and, for that reason, expects that Bidders will treat all materials and data provided by Client as confidential.

Client and the Bidder further agree that all Proprietary and/or Confidential Information will be handled in accordance with the NDA.

1.13 AUTHORIZATION LETTER/ BOARD RESOLUTION:

The bidders need to submit board resolution along with authorization Letter in Online mode authorizing the signatory to act on behalf of the bidder. The Authorized person should be either authorized by Board or a

employee authorized by one of the following person who has the Board Resolution to delegate authorization to other :

1. Managing director
2. The Chief Executive Officer
3. The manager;
4. The Company Secretary
5. The Whole-time director
6. The Chief Financial Officer

The bidder should ensure that the Digital Signature used for uploading the tender document in e tender portal should be of the authorized signatory.

1.14 MOU/AGREEMENT

Selected bidder will have to sign MoU with TCIL (as per format enclosed) before TCIL submits bid to the end client.

1.15 SUBMISSION OF FORGED DOCUMENTS

Bidders should note that TCIL may verify authenticity of all the documents/certificate/information submitted by them against the EOI. In case at any stage of this process, if it is established that bidder has submitted forged documents/certificates/information towards fulfillment of any of the EOI/contract conditions, TCIL shall immediately reject the bid of such bidder(s) or cancel/terminate the contract and forfeit bid security / Performance Security submitted by the bidder and debar them from participation in future tenders of TCIL for a period upto 5 years.

1.16 CLARIFICATION FROM BIDDERS

The queries may be asked from bidders for submitting shortfall to be submitted within specified date and time. Also, every document submitted against following queries should be signed by the person authorized as per Authorization letter / Board Resolution submitted by bidder against tender, without which the documents will not be accepted as valid.

1.17 REGISTRATION OF MSE VENDORS

Deleted

1.18 The bidder must ensure that their bid is complete in all respects and conforms to EOI terms and conditions, EOI specifications etc. including client specifications, failing which the bids are liable to be rejected without seeking any clarifications on any exception/deviation taken by the bidder in their bid.

1.19 TCIL reserves the right to accept or reject any or all the EOIs without assigning any reason.

1.20 CONTACT INFORMATION

Project Division:

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Telephone: +968-99215276
e-mail: pmoman@tcil.net.in
tciloman@tcil.net.in

END OF SECTION-1**SECTION-2****GENERAL TERMS & CONDITIONS OF THE CONTRACT****2.1 FINANCING OF TRADE RECEIVABLES OF MSE'S THROUGH TRADE RECEIVABLES DISCOUNTING SYSTEM (TREDS) PLATFORM**

Deleted

2.2 PRICE PREFERENCE TO MICRO AND SMALL ENTERPRISES

Deleted.

2.3 PURCHASE PREFERENCE: MAKE IN INDIA

Deleted

2.4 RESTRICTIONS ON PROCUREMENT FROM A BIDDER OF A COUNTRY WHICH SHARES A LAND BORDER WITH INDIA

Deleted

2.5 RISK PURCHASE

- a) In case, the sub-contractor/ Supplier is not performing its obligations under the contract, the notice shall be sent as per law to the sub-contractor informing that in case of non performance by a particular date/period, the contract shall be terminated and the work/project will be executed (through a third party) at the risk and cost of the said sub-contractor/ supplier as per the terms of the contract.
- b) On completion of the specified period/date, the notice of termination shall be issued clearly specifying that the remaining work shall be executed (through a third party) at the risk and cost of the sub-contractor/supplier. Along with this notice of termination, intimation shall be sent to the said sub-contractor/supplier for joint preparation of inventory of the works performed/ supplies already undertaken by him. If the sub-contractor/supplier fails to turn up on an appointed date for joint preparation of inventory, in that situation he shall be proceeded ex parte and the inventory shall be prepared by TCIL/Employer and the same be sent to the sub-contractor/supplier.
- c) Further at the time of award of work to another sub-contractor/ Supplier, if the work is awarded at an additional cost than the original sub-contractor/ Supplier, another notice may be issued to the original sub-contractor/ Supplier specifying that the work has been awarded to another agency at the additional cost of such and such amount, and he is liable to pay that amount to TCIL.
- d) Demand notices may be sent to the original sub-contractor/ Supplier from time to time.

2.6 GENERAL LIEN / SET-OFF

- a) Whenever under this contract, any sum of money is recoverable from and payable by the supplier, the purchaser shall be entitled to recover such sum by appropriating in part or in whole the security deposit of the supplier, if a

security is taken from the supplier. In the event of the security being insufficient or if no security has been taken from the supplier, the balance or the total sum recoverable, as the case may be, shall be deducted from any sum due to the supplier or which at any time thereafter may become due to the supplier under this or any other contract with the purchaser. Should this sum be not sufficient to cover the full amount recoverable, the supplier, shall pay to the purchaser on demand the remaining balance due.

- b) Any some of money (including refundable security deposit) due and payable to the supplier, under this contract or any other contract entered between the parties herein whether continuing or completed may be appropriated by TCIL and set off against any claim of TCIL of any nature whatsoever, arising under this contract or any other contract entered into between the parties, herein whether continuing or completed.

2.7 REPEAT/ADD-ON ORDER

- a) In exceptional situation where the requirement is of an emergent nature, the purchaser reserves the right to place repeat order up to 50% of the value of goods and services contained in the running tender/contract within a period of twelve months from the date of commissioning/ commercialization of the project (date of acceptance of APO of the items procured in case where no installation, commissioning is involved) at the same rate or a rate negotiated (downwardly) with the existing venders considering the reasonability of rates based on prevailing market conditions and the impact of reduction in duties and taxes etc.
- b) Further if required, an additional order for 50% of the value of the goods & services limited to 100% of the value of goods and services contained in the running tender/contract may be placed within a period of twelve months from the date of commissioning/ commercialization of the project (date of acceptance of APO of the items procured in case where no installation, commissioning is involved) on the existing vendors at the same rate or a rate negotiated (downwardly) considering the reasonability of rates based on prevailing market conditions and the impact of reduction in duties and taxes etc.(with due approval of the Board).

2.8 PURCHASERS RIGHT TO VARY QUANTITIES

TCIL will have the right to increase or decrease up to 25% of the value of goods and services specified in the schedule of requirements without any change in the unit price or other terms and conditions at the time of award of contract.

2.9 FORCE MAJEURE

The supplier shall be exempted from the responsibility for any non-performance arising from a case of force majeure or act of God, hereinafter called force majeure (a) war and (b) earthquake. If such circumstances should arise, the supplier shall inform the purchaser within 72 hours in writing of the existence of the fact before suspending work without penalty on either side from the period of such suspension not exceeding 3 months. Likewise, it must proceed to inform the end of such fact. As soon as the facts constituting a force majeure cease in their effects, the supplier shall restart or continue the fulfillment of its obligations agreed upon. Should suspension of work as explained above exceed three months, the contract shall be violable at the option of either party without penalty on either side.

2.10 ARBITRATION

All disputes or differences whatsoever arising among the parties under and/or in connection with and/or in respect of this tender shall be referred to and decided by a sole arbitrator, who shall be nominated by the CMD, TCIL. The arbitration shall be conducted in accordance with local law of Sultanate of Oman, as amended from time to time and the venue of the arbitration shall be in Oman

For Public Sector Undertaking / Government Departments: "In the event of any dispute or difference relating to the interpretation and application of the provisions of this contract, such dispute or difference shall be taken up by either party for resolution through AMRCD as mentioned in DPE OM No. 4(1)/2013-DPE (GM)/FTS-1835 dated 22.05.2018.

Any party aggrieved with the decision of the committee at the Ist level (tier) may prefer an appeal before the Cabinet Secretary at the Second level (tier) within 15 days from the date of receipt of decision of the committee at First level, through its Administrative Ministry/ Deptt in terms of para 4, 5 and 7 of above DPE OM dated 22.05.2018, whose decision will be final and binding on all concerned.”

2.11 FALL CLAUSE

- a) The prices once fixed will remain valid during the scheduled delivery period. Further, if at any time during the contract
- It comes to the notice of purchaser regarding reduction of price for the same or similar equipment/ service;
 - And/or
 - The prices received in a new tender for the same or similar equipment/service are less than the prices chargeable under the contract.

The purchaser, for the purpose of delivery period extension/during rate contract, if any, will determine and intimate the new price, taking into account various related aspects such as quantity, geographical location etc., and the date of its effect for the balance quantity/ service to the vendor. In case the vendor does not accept the new price to be made applicable during the extended delivery period and the date of its effect, the purchaser shall have the right to terminate the contract without accepting any further supplies. This termination of the contract shall be at the risk and responsibility of the supplier and the purchaser reserves the right to purchase the balance unsupplied quantity/ service at the risk and cost of the defaulting vendor besides considering the forfeiture of his performance security.

- b) The vendor while applying for extension of time for delivery of equipment/services, if any, shall have to provide an undertaking as “We have not reduced the sale price, and/ or offered to sell the same or similar equipment/ service to any person/organization including Department of central/state Government or any central/state PSU at a price lower than the price chargeable under the contract for scheduled delivery period.”

In case under taking as in (b) above is not applicable, the vendor will give the details of prices, the name(s) of purchaser, quantity etc. to the purchaser, while applying extension of delivery period.

2.12 OFFLINE DOCUMENTS

Deleted

2.13 BANNING OF NON-PERFORMING VENDOR

In case any of the vendor’s work/PO/agreement is cancelled/terminated by TCIL after award, due to non-performance, the vendor may be banned/blacklisted upto 5 years or action as deemed fit may be taken by TCIL

2.14 AMENDMENT TO BID DOCUMENTS

- a) At any time, prior to the date of submission of bids, TCIL may for any reason, whether at its own initiative or in response to a clarification requested by a prospective bidder, modify the bid documents by amendments, which shall be available on TCIL Website and the e-tendering portal.
- b) In order to give required time to the prospective bidders, in which to take the amendments into action in preparing their bid, TCIL may at its discretion extend the deadline for submission of bid suitably.

2.15 BID PRICE

The prices quoted by the bidder shall remain firm during the entire period of the contract and shall not be subject to variation (unless asked by TCIL). Clauses such as “at actual”, “extra”, “to be given later” etc. shall also be treated as non-responsive & are liable for rejection.

2.16 MODIFICATION AND WITHDRAWAL OF BIDS

- a) Bid withdrawal/modification shall not be allowed after end date and time of bid submission.
- b) Withdrawal of a bid between the deadline for submission of bids and the expiration of the period of bid validity specified in the tender or as extended, may result in the forfeiture of the bid security. Such defaulting vendor is liable to be debarred from participating in future bids for a period of upto 2 years.

2.17 CLARIFICATION OF BIDS

During evaluation of bids, TCIL may at its discretion ask the Bidder for clarifications/ confirmations/ deficient documents of its bid. The request for clarification and the response shall be in writing and no change in the price of substance of the bid shall be sought or permitted.

2.18 TERMINATION FOR DEFAULT

- a) TCIL may, without prejudice to any other remedy for breach of contract, by written notice of default, sent to the supplier, terminate this contract in whole or in part.
 - if the supplier fails to deliver any or all the services/goods within the time period specified in the contract, or any extension thereof granted by TCIL.
 - if the supplier fails to perform any other obligation(s) under the contract;
 - if the supplier, in either of the above circumstances, does not remedy his failure within a period of 15 days (or such longer period as TCIL may authorize in writing) after receipt of the default notice from TCIL.
 - Failure of the successful bidder to comply with the requirement of submission of performance security shall constitute sufficient ground for cancellation of the award of work and forfeiture of the bid security.
- b) In the event TCIL terminates the contract in whole or in part pursuant to above clause, TCIL may procure, upon such terms and in such manner as it deems appropriate, goods/services similar to those undelivered and the supplier shall be liable to TCIL for any excess cost for such similar goods/services. However, the supplier shall continue the performance of the contract to the extent not terminated.

2.19 TERMINATION FOR INSOLVENCY:

TCIL may at any time terminate the contract by giving written notice to the supplier, without compensation to the supplier, if the supplier becomes bankrupt or otherwise insolvent as declared by the competent court; provided that such termination will not prejudice or affect any right of action or remedy which has accrued or will accrue thereafter to TCIL.

- 2.20** At any time, in case it comes to the knowledge of TCIL any of wrong information related with eligibility of the bidder or non-compliance to any terms and conditions of tender, then TCIL reserves the right to cancel or reject the bid of such bidder, cancel the tender or take any other action as deemed fit in accordance with tender terms and conditions.

2.21 ADDITIONAL CLAUSES FOR DEBARMENT:

- A. A bidder or any of its successor, shall be debarred from participating in any procurement process undertaken by TCIL for a period not exceeding **three (3) years** if he has been convicted of an offence as under:
 - a) under the Prevention of Corruption Act, 1988; or

- b) the Indian Penal Code or any other law for the time being in force, for causing any loss of life or property or causing a threat to public health as part of execution of a public procurement contract.

B. A bidder or any of its successor, shall be debarred from participating in any procurement process undertaken by TCIL for a period not exceeding **two (2) years** if the following code of integrity as per rule 175 of GFRs 2017, is breached:

1. prohibition of
 - a) making offer, solicitation or acceptance of bribe, reward or gift or any material benefit, either directly or indirectly, in exchange for an unfair advantage in the procurement process or to otherwise influence the procurement process.
 - b) any omission, or misrepresentation that may mislead or attempt to mislead so that financial or other benefit may be obtained or an obligation avoided.
 - c) any collusion, bid rigging or anticompetitive behaviour that may impair the transparency, fairness and the progress of the procurement process.
 - d) improper use of information provided by the procuring entity to the bidder with an intent to gain unfair advantage in the procurement process or for personal gain.
 - e) any financial or business transactions between the bidder and any official of the procuring entity related to tender or execution process of contract; which can affect the decision of the procuring entity directly or indirectly.
 - f) any coercion or any threat to impair or harm, directly or indirectly, any party or its property to influence the procurement process.
 - g) Obstruction of any investigation or auditing of a procurement process.
 - h) ***making false declaration or providing false information*** for participation in a tender process or to secure a contract;
2. disclosure of conflict of interest.
3. Disclosure by the bidder of any previous transgressions made in respect of the provisions of sub-clause (i) with any entity in any country during the last three years or of being debarred by any other procuring entity.

C. A bidder or any of its successor, shall be debarred from participating in any procurement process undertaken by TCIL for a period not exceeding **two (2) years** if the following is breached:

- (i) If a Bidder withdraws the proposal or increases the quoted prices after opening of the Proposal and during the period of Bid validity period or its extended period, if any.
- (ii) In case of a successful Bidder, if the Bidder fails to sign the Agreement in accordance with the terms and conditions (including timelines for execution of the Agreement) of this tender or fails to furnish the Performance Bank Guarantee in accordance with the terms and conditions (including timelines for furnishing PBG) of this tender.
- (iii) During the Bid process, if a Bidder indulges in any act as would jeopardize or unnecessarily delay the process of bid evaluation and finalization.

D. The debarment in all cases shall be automatically extended to all its allied firms. In case of Joint ventures/Consortium is debarred all partners shall also stand debarred for a period specified in debarment order. The names of partners should be clearly specified in the debarment order.

END OF SECTION-2

SECTION – 3

SPECIAL CONDITIONS OF CONTRACT

Note: In case clauses/ sub-clauses have any difference mentioned in this EOI at different places, the conditions mentioned in the end client shall prevail. The terms and conditions of this section shall be on back to-back basis of end client's tender as well.

3.1 PAYMENT TERMS – BACK-TO-BACK BASIS

PAYMENT CONDITIONS: **BACK-TO-BACK BASIS** AS PER SOW TERMS. The prices shall be on local contract basis for delivery of equipment to site. Prices shall be inclusive of all taxes, dues, etc., as required by local regulations and in accordance with the Standard Conditions of Contract.

3.2 PERFORMANCE SECURITY

- a) The bidder will submit an undertaking to submit back-to-back PBG (Performance Security) as submitted by TCIL to end Client or at least 5% of the contract value or as decided on case-to-case basis, if the contract is awarded to TCIL.
- b) Deleted
- c) The proceed of the performance security shall be payable to TCIL in case of breach of any of the terms and conditions of the contract/PO/tender by the vendor. Recovery/adjustment due to LD or any other loss to TCIL shall be in addition to point f).
- d) The performance security will be discharged by TCIL after completion of supplier's obligations, including any warranty obligations, under the contract.
- e) PBG should be valid as per requirement of Client. The PBG shall be refunded once the PBG of TCIL is returned by the client.
- f) Failure of the successful bidder to submit the Performance Security or bidders' failure to complete its obligations under the contract shall constitute sufficient ground for the annulment of the award / cancellation of the award of work and forfeiture of the bid security/performance security.
- g) Additionally, TCIL reserves the right to debar such defaulting bidder from participating in future bids for a period up to 2 years.

3.3 PRICE BASIS

The price format for the proposal should be as per the format provided by end Client SOW.

3.4 PAYING AUTHORITY

Chief Executive Officer, TCIL, Oman

3.5 INSURANCE

After the signing of the Agreement or acceptance of the Letter of Acceptance and prior to the commencement of the work, the Contractor shall insure against any damage, loss or injury which may occur to any property (including that of the Client) or to any person (including any employee of the Client) by or arising out of the execution of the Works or in the carrying out the Contract.

Such insurance shall be as per the client requirement.

3.6 DELIVERY / IMPLEMENTATION SCHEDULE

The Tenderer shall submit a detailed schedule of delivery and implementation starting from the date of issuing the work order until the end of the contract period including factory test, shipment and delivery on site, installation, testing and commissioning. However, the time for completion of the shall be as per end client.

3.7 WARRANTY

As per Client's Terms and conditions

3.8 PERIOD OF CONTRACT

As per Client's Terms and Conditions.

3.9 TERMINATION OF CONTRACT

- i) If, during the term of the Contract, the Contractor commits a breach of the Contract and provided that such breach is capable of being remedied, the Client will serve a written notice to rectify the breach within thirty (7) days of the notice date.
- ii) If the Contractor fails to rectify the breach within the notice period, the Client may immediately terminate the contract by a written notice to the Contractor
- iii) Upon termination of the Contract, the Client may appoint a different contractor to complete the outstanding work of the Contractor or any part thereof. Any costs incurred due to the engagement of the second contractor in excess of the Contract Price shall be borne by the Contractor. In such cases payment only for such materials supplied and useful to the Client up to the date of termination, shall be made.

3.10 PENALTY

Penalty shall be on back to-back basis as per the tender terms. An Undertaking to this effect on bidder's letterhead must be submitted.

3.11 FREE TECHNICAL MAINTENANCE / SLA

Refer SoW

3.12 UPTIME

Refer SoW

3.13 LIQUIDATED DAMAGES

Liquidated Damages charges/ Fines terms with the bidder & shall be on back to-back basis as per the tender terms. An Undertaking to this effect on bidder's letterhead must be submitted.

3.14 DELIVERY PERIOD EXTENSION:

As per end Client's requirement.

3.15 SAFETY REGULATIONS:

Bidder shall be responsible for ensuring that the Services are carried out in accordance with the rules of safety provided by the law and with safe working practice. In particular, the Contractor shall comply strictly with the Company's Safety, Health & Environment regulations in addition to the safety related provisions in the RFQ.

3.16 OTHER REQUIREMENT:

Bidders may be asked to submit other compliance which are not part of this EOI but related to this SoW. Bidders has to give undertaking that if there is any other requirement related to SoW, shall be complied strictly.

END OF SECTION-3

SECTION-4

SCOPE OF WORK & TECHNICAL SPECIFICATIONS

[Please refer attachment]

END OF SECTION-4

SECTION-5**PROJECT EXPERIENCE**

S. No	Item	Details
General Information		
1	Customer Name/Government Department	
2	Name of the Contact Person and Contact details for the Project	
Brief Description of scope of Project		
Size of the Project		
3	Contract Value of the Project (in crore) excluding taxes	
4	Contract Value of the Project (in crore) including taxes	
Project Details		
5	Name of the Project	
6	Start Date & End Date	
7	Current Status (work in progress in %, completed)	
8	Contract Tenure	
9	Type of Project	

END OF SECTION-5**SECTION – 6**

PRICE BID SCHEDULE

(Note for User Division:- This Section can be modified/deleted as per Business/Project requirements.)

To: [Head of Department]

Dear Sir,

We, the undersigned, offer to provide the [Insert title of assignment] against your EOI No. [Insert EOI No.] dated [Insert Date]. Our attached Financial Proposal is for the sum of [Insert amount(s) in words and figures1].

Yours sincerely,

Authorized Signature [*In full and initials*]: _____
Name and Title of Signatory: _____
Name of Firm: _____
Address: _____

[insert price bid format]

Note 1:- The bidder to provide un-priced Price-Bid along with Technical bid.

Notes2:-

- a) Lowest Bid will be on the basis of Grand Total.
- b) Bidder shall mandatory mention the 8 digit / 6 digit applicable HSN / SAC code of all the Quoted items.
- c) In case of change in rate due to change in Taxes/Duties the rate shall be applicable on prorata basis based on actual nos. of applicable days.
- d) Before Submitting their Duly Filled "Price Bid Schedule & BOQ" the bidders should ensure that they do not enter any Comments in the above Table like " As per Actuals, Will be Intimated Later on etc" . If Bidder uses these type of Comments while filling up the above Table for Price Bid Schedule & BOQ Or if the charges for any item is left blank the Charges for the Items wherever such comments are used or if left blank shall be Considered as "Zero" and the same shall be a binding on the bidder.
- e) If there is a discrepancy between the unit price and total price that is obtained multiplying the unit price and quantity, the unit price shall prevail and the total price shall be corrected.
- f) In case of discrepancy between words and figures, the amount in words shall prevail.
- g) The Bidder must specify the make of each product / Line items of the BOQ in the price bid.
- h) The requirement / Quantity mentioned above are indicative & may vary as per the actual requirements.

[Notes can be modified as per Business/Project Requirements.]

END OF SECTION-6

SECTION-7**MANUFACTURER'S AUTHORISATION FORM**

(Note for User Division:- MAF can be modified as per Client's requirements)

[Head of Department]

Telecommunications Consultants India Limited.

TCIL Bhawan, Greater Kailash-I

New Delhi-110 048 (INDIA)

Dear Sir,

Ref: Your [document No] _____ dated _____

We, _____ who are proven and reputable manufacturers of (name and description of the factories at goods offered in the bid) having, hereby authorize M/s (name and address of the agent) to submit a bid, process the same further and enter into a contract with you against your requirement as contained in the above referred documents for the above goods manufactured by us.

We also state that we are not participating directly in this bid for the following reason(s):

_____ (Please provide reason here).

We further confirm that no supplier or firm or individual other than Messrs. _____ (name and address of the above agent) is authorised to submit a bid, process the same further and enter into a contract with you against your requirement as contained in the above referred EOI documents for the above goods manufactured by us.

We also hereby extend our full warranty, CAMC as applicable as per Client's [tender No.] and [tender name], read with modification, if any, for the goods and services offered for supply by the above firm against this EOI document.

We also hereby confirm that we would be responsible for the satisfactory execution of contract placed on the authorized agent and the spares for the equipment shall be available for at least 10 years from the date of supply of equipment.

We also confirm that the price quoted by our agent shall not exceed the price which we would have quoted directly"

Yours faithfully,

[Signature with date, name and designation]

for and on behalf of M/s _____

[Name & address of the manufacturers]

Note: I. This letter of authorization should be on the letter head of the manufacturing firm and should be signed by a person competent and having the Authorization letter / Board Resolution to legally bind the manufacturer.

2. Original letter may be sent.

END OF SECTION-7

SECTION - 8**BID SECURITY DECLARATION FORMAT**

We, the undersigned, declare that:

We , M/s.....(herein referred as bidder) understand that, according to bid clause No., bids may be supported with a Bid Securing Declaration, therefore rather than submitting the Earnest Money Deposit, bidder render the declaration that:-

Bidder will automatically be suspended from being eligible for bidding in any contract with TCIL (herein referred as Purchaser) for the period upto 5 years, starting on bid submission closing date, if bidder are in breach of any of the following obligation(s) under the bid conditions:-.

- a) If a Bidder withdraws the proposal or increases the quoted prices after opening of the Proposal and during the period of Bid validity period or its extended period, if any.
- b) In case of a successful Bidder, if the Bidder fails to sign the Agreement in accordance with the terms and conditions (including timelines for execution of the Agreement) of this tender or fails to furnish the Performance Bank Guarantee in accordance with the terms and conditions (including timelines for furnishing PBG) of this tender.
- c) During the Bid process, if a Bidder indulges in any act as would jeopardize or unnecessarily delay the process of bid evaluation and finalization.
- d) Bidder understand that this declaration shall expire if Bidder are not the successful Bidder and on receipt of purchaser's notification of the award to another Bidder; or thirty days after the validity of the Bid; whichever is earlier.

(Signature)

Authorized Signatory

Name : _____

Designation: _____

Office Seal: _____

Place: _____

Date: _____

END OF SECTION-8

SECTION-9

INTEGRITY PACT

[As per format given in TCIL Website – Link https://www.tcil.net.in/public/pdf/integrity_pact.pdf

END OF SECTION-9

SECTION-10**AUTHORIZATION LETTER****Format for Authorization letter to be submitted by Bidder**

Know all men by these presents that we (name of Company) _____, incorporated in India under the Companies Act, 1956 and having its Registered Office at _____. (India) ("Hereinafter called the Company") DOTH hereby nominate, constitute and appoint (Name, Designation) _____, S/o _____ to be true and lawful authorized signatory in fact and at law of the Company for and in the name and on behalf of the Company, to do, execute and perform all or any of the following acts, deeds, matters and things namely:-

1. To represent the Company to all intents and purposes in connection with the matters pertaining to signing & submission of (EOI No, EOI Date, EOI Description)_____, _____, _____and all affairs ancillary or incidental thereto.
2. AND the Company hereby agrees that all acts, deeds and things lawfully done by the said authorized signatory shall be construed as acts, deeds and things done by the Company itself and the Company hereby undertakes to ratify and confirm all and whatever its authorized signatory shall lawfully do or cause to be done for and on behalf of the Company by virtue of the powers hereby given.

In witness whereof (Name , Designation) _____, _____of the Company acting for and on behalf of the Company under the authority conferred by the Board of Directors of the Company in its _____ meeting held on (Date) _____ has signed this Authorization Letter at (place)_____on this (Date) _____.

The signatures of (Name , Designation) _____ given below are hereby certified.

Signature : _____

SIGNATURES OF (Name , Designation) _____

CERTIFIED

Signature : _____

WITNESS:-

Signature:_____

(Name , Designation):_____

END OF SECTION-10

SECTION-11

CALCULATION OF LOCAL CONTENT:

As per the attached tender documents – See documents related to In-Country Value (ICV)

END OF SECTION-11

SECTION-12**NO-CONVICTION CERTIFICATE****[To be submitted on the Letterhead of the Bidder]**

Offer No.: _____

Date: _____

To

[Head of Department]

Telecommunications Consultants India Limited,

TCIL Bhawan, Greater Kailash-I,

New Delhi-110 048 (INDIA)

Sub: Self Declaration of not been blacklisted for [EOI No.] dated [EOI date]

Dear Sir,

This is to notify you that our Firm /Company/ Organization <provide Name of the Firm/ Company/ Organization> intends to submit a proposal in response to [EOI No.] dated [EOI date] for [EOI Name].

In accordance with the above, we declare that:

- a. We are not involved in any major litigation that may have an impact of affecting or compromising the delivery of goods / services as required under this [EOI No] dated [EOI date].
- b. We are neither banned/ debarred/ blacklisted/ put on holiday list nor action for banning / debarment / blacklisting / holiday listing has been initiated by any Central/ State Government/ agency of Central/ State Government of India or any other country in the world/ Public Sector Undertaking/ any Regulatory Authorities in India or any other country in the world for any kind of fraudulent activities on any ground including but not limited to indulgence in corrupt practice, fraudulent practice, coercive practice, undesirable practice or restrictive practice as on date of submission of the Bid.

Yours sincerely,

(Signature of the Authorized signatory of the Bidding Organisation)

Name:

Designation:

Contact details (including E-mail):

Business Address:

Date:

Seal:

END OF SECTION-12

SECTION-13**BID SUBMISSION FORM**

Offer No.:

Date:

To: [Head of Department], TCIL

Dear Sir,

In response to your Tender No. _____, we hereby submit our offer herewith.

1. Bidder Name : _____

2. Website Address : _____

3. Email Address : _____

4. Address for Communication : _____

5. Telephone Number : _____

6. Fax/Telefax Number : _____

7. Authorised Person - Name : _____

Designation : _____

Mobile No. : _____

Email ID : _____

8. Alternate Person Name: : _____

Designation : _____

Mobile No. : _____

Email ID : _____

9. PAN Number : _____

10. GST Regn. No. with Address : _____

11. Beneficiary's complete Bank Details.

Bank Account No. : _____

IFSC / NEFT Code : _____

Name of the Bank : _____

Address of the Branch : _____

12. Particulars of EMD

Amount : Rs. _____

Mode of Payment (DD/BG) : _____

DD/BG No. : _____

Date : _____

Name of the Bank : _____

Address of the Bank : _____

Validity of BG : _____

13. Particulars of Tender Fee

Amount : Rs. _____

DD No. : _____

Date : _____

Name of the Bank : _____

Address of the Bank : _____

14. Turnover of the Bidder in last 3 years:-

Year	Year Annual Report attached at Page No.	Turnover in Rs. (Lakh)
Average Turnover		

15. Are you a MSME Unit. If yes, please furnish Registration Details, Name of the DIC/State.

16. If you are MSME, is it owned by SC/ST Entrepreneurs or Women Entrepreneurs? If Yes, please specify the Name of the Owner who is SC or ST or Women Entrepreneur (as applicable).

17. Following Documents are submitted to substantiate other eligibility criteria.

i) _____

ii) _____

iii) _____

DECLARATION

- 1) We have read and understood the terms & conditions of the above-mentioned tender and comply to all Terms & Conditions of the Tender.

(In case of any deviation, the Bidder must attach a separate sheet clearly mentioning the Clause No. of the Tender and Deviation thereto)

- 2) We certify that the information mentioned above are true and correct to best of our knowledge.

Place:

Signature of Authorised Signatory with Seal

Date:

Name:

Designation:

END OF SECTION -13

SECTION-14

MAKE IN INDIA UNDERTAING

Not Applicable

END OF SECTION-14

SECTION-15
EOI CHECKLIST

S.No	Document	Submitted (Yes or No)
1	Tender Fee	
2	EMD (BG/DD/NEFT etc.)	
3	For MSME Exemption, Udyam Registration Certificate and Statutory Auditor Certificate for Investment in Plant and Machinery.	
4	For StartUp DPIIT certificate	
5	Authorization Letter/Board Resolution	
6	MAKE IN INDIA Undertaking	
7	Certificate of Incorporation/ Registration/ Partnership Deed or any other	
8	Financial criteria	
9	Similar Experience Criteria	
10	Pan & GST	
11	MAF	
12	Insolvent Undertaking	
13	No-Conviction Certificate	
14	Land Border Sharing Declaration	
15	Unpriced BOQ	
16	Undertaking from Vendors for non-cancellation of Purchase Order(s) on risk and cost on risk & cost basis or non-performance.	
17	PF Registration	
18	Local Office Undertaking	
17	Labor Laws Compliance Undertaking	
18	Consortium Agreement	
19	Genuine Documents Undertaking	
20	No-Deviation Certificate/ Clause-by Clause Compliance	
21	Technical Brochure and Data Sheet	
22	Integrity Pact document as applicable	
23	Bid Submission Form	
24	NDA as applicable	
25	Any Other Undertaking/ document as per EOI.	

END OF SECTION-15

SECTION-16**RATE CONTRACT**

[The following terms and conditions need to be included in Rate Contracts. Other terms and conditions shall be as per EOI format.]

1. The quantity to be supplied during the currency of the rate Contract is not fixed and will be decided based on their actual requirement as per approved Budget/ Indent on “as and when” required basis.
2. The User Division needs to define total volume of work [x] and period of contract.
3. The User Division needs to define maximum one-time order [Rs. y] , which will be placed on the bidder. The Eligibility and financial Turnover shall be as per Eligibility Criteria of EOI calculated based on max. one time order value i.e. Rs. [y] as estimated cost.
4. The Company can place the orders during the validity of the rate contract period at the same rate, terms and conditions.
5. Normally, no variation is allowed except statutory variations in Sales Tax and Excise Duties. Sometimes, there are significant variations in the raw-material prices during the rate contract period. If there are downward variations and the client insists for revised quotations, the earlier rate contract is cancelled and new tenders are invited.

6. **FALL CLAUSE (applicable for Rate Contract)**

- a) The prices once fixed will remain valid during currency of rate contract. Further, if at any time during the contract
 - It comes to the notice of purchaser regarding reduction of price by the supplier/vendor for the same or similar equipment/ service;And/or
 - The prices received in a new tender for the same or similar equipment/service are less than the prices chargeable under the contract.

The purchaser, for the purpose of rate contract, if any, will determine and intimate the new price, taking into account various related aspects such as quantity, geographical location etc., and the date of its effect for the balance quantity/ service to the vendor. In case the vendor does not accept the new price to be made applicable during the extended delivery period and the date of its effect, the purchaser shall have the right to terminate the contract without accepting any further supplies. This termination of the contract shall be at the risk and responsibility of the supplier/vendor/contractor and the purchaser reserves the right to purchase the balance unsupplied quantity/ service at the risk and cost of the defaulting vendor besides considering the forfeiture of his performance security.

- b) The vendor during any time of the currency of the rate contract, shall have to provide an undertaking as “We have not reduced the sale price, and/ or offered to sell the same or similar equipment/ service to any person/organization including Department of central/state Government or any central/state PSU at a price lower than the price chargeable under the contract for scheduled delivery period.”

In case clarification is required by TCIL, the vendor supplier shall produce related documents such as PO/Agreement etc.

END OF SECTION-1

Section -17**PERFORMANCE BANK GUARANTEE (PBG Format)**

**M/s Telecommunications Consultants India Ltd.,
Muscat, Sultanate of Oman**

(With due stamp duty if applicable)

OUR LETTER OF GUARANTEE No. : _____

In consideration of TELECOMMUNICATIONS CONSULTANTS INDIA LIMITED, having its office at Muscat (PO Box 2292, PC 112, Ruwi, Muscat, Sultanate of Oman) (hereinafter referred to as "TCIL" which expression shall unless repugnant to the content or meaning thereof include all its successors, administrators and executors) and having entered into an agreement dated _____/issued Purchase Order No. _____ dated _____ with/on _____ M/s _____ (hereinafter referred to as "The Supplier" which expression unless repugnant to the content or meaning thereof, shall include all the successors, administrators, and executors).

WHEREAS the Supplier having unequivocally accepted to supply the materials/Services as per terms and conditions given in the Agreement dated _____ /Purchase Order No. _____ dated _____ and TCIL having agreed that the Supplier shall furnish to TCIL a Performance Guarantee for the faithful performance of the entire contract, to the extent of 10% (ten percent) of the value of the Purchase Order i.e. for _____.

We, _____ ("The Bank") which shall include OUR successors, administrators and executors herewith establish an irrevocable Letter of Guarantee No. _____ in your favour for account of _____ (The Supplier) in cover of performance guarantee in accordance with the terms and conditions of the Agreement/Purchase Order.

Hereby, we undertake to pay upto but not exceeding _____ (say _____ only) upon receipt by us of your first written demand accompanied by your declaration stating that the amount claimed is due by reason of the Supplier having failed to perform the Agreement and despite any contestation on the part of above named supplier.

The proceed of performance security shall be payable to TCIL in case of breach of any of the terms and conditions of the contract/PO/tender by the vendor.

This Letter of Guarantee will expire on _____ including 30 days of claim period and any claims made hereunder must be received by us on or before expiry date after which date this Letter of Guarantee will become of no effect whatsoever whether returned to us or not.

Authorized Signature
Manager
Seal of Bank
Contact details

END OF SECTION-17**SECTION-18****Memorandum of Understanding****ANNEXURE – I**

This Memorandum of Understanding (MoU) is made on ____th day of _____ at New Delhi by and between:

M/s Telecommunications Consultants India Limited, a Company registered under the Indian Companies Act 1956, with its registered and corporate office at TCIL Bhawan, Greater Kailash-1, New Delhi – 110048, hereinafter referred to as “**TCIL**”, which expression shall include its successors and its permitted assigns, of one part.

AND

M/s _____ (**vendor name**), registered under the Indian Companies Act 1956/2013 (whichever is applicable), with its registered office at _____, hereinafter referred to as “_____”, which expression shall include its successors and permitted assigns, of the other part.

“TCIL” and “_____” are individually referred to as “Party” and collectively as “Parties”.

WHEREAS TCIL, a Government of India Enterprise under the Ministry of Communications and Information Technology, is a leading company in Telecommunications and Information Technology and has to its credit successful execution of many consultancy and turnkey projects in the fields of Telecom, IT and Civil both in India and abroad and it also acts as procurement consultant/agent/executing agency/implementing agency for number of Government of India enterprises/undertaking.

WHEREAS _____ (vendor name) is in the business of _____.

WHEREAS _____ (Client Name) (herein after called “_____”) issued TENDER No. _____ dated _____ for ‘_____, hereinafter referred to as “_____ (Client Name) tender” /”Work”/”Project”.

WHEREAS TCIL published EOI No. _____ dated _____ (hereinafter referred as TCIL EOI) for selection of back-end partner for _____ (Client Name) tender.

AND WHEREAS _____ (Vendor Name) submitted their offer and pursuant to the same was selected by TCIL as back-end partner for _____ (Client Name) Tender.

Now, therefore, it is agreed between the Parties as under:

1. The Parties wish to work together with the understanding that TCIL shall act as the bidder (lead bidder) and _____ (vendor name) (partner for _____) for participating in the _____ (client name) Tender.
**Please note that the term “Lead bidder” shall be mentioned only when TCIL shall bid in consortium with backend partner.*
2. _____ (vendor name) shall not participate directly in _____ (client name) Tender and shall not quote rates to any other party participating/pre-qualified for _____ (client name) Tender directly or indirectly through its subsidiary, partnership, ownership, individual firm etc.
3. On award of the work of the _____ (client name) Tender to TCIL, TCIL will enter into a detailed agreement with _____ (vendor name) based on the terms & conditions of this MoU, TCIL EOI and _____ (client name) Tender.

4. The term of this MoU shall be for _____ months (“Term”) from the date of signing of this MoU (“Effective Date”) or till the completion of the project & release of all payments thereof whichever is later. All obligations hereunder shall only apply during the Term of this MoU and to such obligations and commitments in relation to the Tender/Work/Project under the scope of TCIL EOI & _____ (Client name) tender, as may have been undertaken by the Parties during the Term with validity exceeding the Term. The Term of this MoU can be extended by mutual agreement between the Parties, depending upon the requirement.
5. After mutual consultation, a joint team consisting of representatives of the parties will be formed for various activities like, technical discussions, deciding the preparation of final Bid/offer, terms & conditions and demonstration of functionality required in the _____ (Client name) Tender/Work/Project.
6. TCIL and _____ (vendor name) hereby mutually agree that both of them shall remain as irrevocable members of this tie-up for the complete execution and completion of _____ (client name) Tender/Work/Project (as per scope of TCIL EOI & _____(Client name) tender).
7. Expenses towards bid preparation would be borne by the individual Parties viz. TCIL and _____ (vendor name) for their respective work. TCIL will not reimburse any such expenses to _____ (vendor name) towards preparation and submission of the bid.
8. All technical, financial and commercial terms and conditions of the Tender, except pricing, risk purchase, limitation of liability, advance payment & termination, will apply on back-to-back basis between TCIL and _____ (vendor name), for their respective part/scope of work. However, if _____ (vendor name) fails to fulfill its part of the work to the satisfaction of TCIL, then TCIL shall have the right to terminate the contract with _____ (vendor name) and get the same executed departmentally or by other agencies at the risk and cost of _____ (vendor name).
9. Notwithstanding anything contained in any other agreement, document, correspondence, arrangement between the parties in respect of _____(Client name) Tender/ Works / Projects, the _____ (vendor name) understands, agrees and undertakes that:
 - a) _____ (vendor name) participated in TCIL EOI and that all terms & conditions of the TCIL EOI shall apply to _____ (vendor name).
 - b) Prices quoted by _____ (vendor name) shall remain firm and fixed till the execution of the Tender.
 - c) the payments terms between TCIL & _____ (vendor name) are on back to back basis and the payment shall be released to _____ (vendor name) by TCIL only if and when received by TCIL from _____ (Client name) and subject to submission of complete documents and invoices etc. by it.
 - d) _____ (vendor name) will not demand or make any claim under any law with respect to the pending payment till the time corresponding payment is received by TCIL from _____ (Client name). TCIL shall not be responsible in any manner whatsoever for any delay in releasing the payments or withholding of payments by _____ (Client name).
 - e) the (day) date of delivery of goods and/or rendering of services by the _____ (vendor name) shall be the date of realization of payment from the client once the goods and/or services are accepted by the client.
 - f) if in the instant contract, _____ (vendor name) is acting only as trader / reseller / distributor/authorized agents and/or is engaged in a WORKS contract, no benefits under MSME Act 2006 and PPP Policy 2012 as per MSE Guidelines issued by Ministry of MSME would be applicable to it on account of acceptance of back to back payment terms as above. By agreeing to the terms of _____ (client name) Tender, the _____ (vendor name) agrees to forgo its rights under this Act and Policy.
 - g) _____ (vendor name) hereby agrees to ensure timely GST compliances as per the statutory requirements. All the costs pertaining to any GST non-compliance including but not limited to any loss of eligible input tax credit due to non-payment/non-filing of GST return and applicable interest/penalties shall be borne/indemnified by _____ (vendor name). Further _____ (vendor name) hereby agrees that TCIL reserves the right for reimbursement of any such cost incurred out of the aforesaid non-compliance(s). _____ (vendor name) will provide payment of GST proof i.e. GSTR-1, GSTR-3B, cash ledger and challan for taking GST payment from TCIL against invoices.

- h) Any deductions by the ____ (Client name) towards LD/penalties/contingencies shall be borne by ____ (vendor name) in terms of TCIL EOI.
 - i) At any given point of time, ____ (vendor name) may not assign or delegate its rights, duties or obligations under this MOU without prior written consent of TCIL.
 - j) On award of work of the Tender/Work/Project, ____ (vendor name) shall provide its GeM Seller id to TCIL (not applicable for “works” contract or non-Indian vendor).
 - k) In the event of breach of any of the terms & conditions of this MOU or in case of any default of any terms & conditions of this MOU, on the part of the ____ (vendor name), TCIL reserves the right to take necessary steps / action as per available documents, including but not limited to, termination of contract, forfeiture of BG / EMD, blacklisting / banning etc. and execute the work at their risk & cost.
10. TCIL and ____ (vendor name) agree to keep confidential all information shared with each other and disclose to third party only after taking prior written consent of each other. This clause excludes information available in public domain. The confidentiality provisions of this MoU shall remain in full force and effect during the term of this MoU and 12 months thereafter.
11. Any sum of money (including refundable security deposit) due and payable to the ____ (vendor name), under this contract or any other contract entered between the parties herein whether continuing or completed may be appropriated by TCIL and set off against any claim of TCIL of any nature whatsoever, arising under this contract or any other contract entered into between the parties, herein whether continuing or completed.
12. Nothing in this MoU shall constitute, create or give effect or recognize a JV, partnership or business entity of any kind.
13. This MoU shall be construed and governed by the laws of India and the parties hereby submit to the exclusive jurisdiction of the Delhi Courts of Law.
14. Any matter, which is not stipulated in the MoU, shall be settled in good faith by discussion among the parties in the spirit of understanding and cooperation.
15. All disputes or differences whatsoever arising among the parties under and/or in connection with and/or in respect of this MoU shall be referred to and decided by a sole arbitrator, who shall be nominated by the CMD, TCIL. The arbitration shall be conducted in accordance with the Arbitration and Conciliation Act of 1996, as amended from time to time and the venue of the arbitration shall be in New Delhi.
- *Please Note that in case of agreement/MoU with Government Organization, the following clause shall be applicable:*
- In the event of any dispute or difference relating to the interpretation and application of the provisions of the commercial contract(s) between Central Public Center Enterprise (CPSEs)/Port Trusts inter se and also between CPSEs and Govt. Depts/ organizations (excluding disputes relating to Railways, Income Tax, Customs & Excise Dept), such dispute or difference shall be taken up by either party for its resolution through AMRCD as mentioned in DPE OM No. 05/003/2019-FTS-10937 dated 14th December 2022 and the decision of AMRCD on the said dispute will be binding on both the parties
16. During its Term, this MOU will be terminated in the event of
- a. Client withdrawing the Tender provided it does not create any financial obligation on TCIL.
 - b. Tender not awarded to TCIL
 - c. Mutual agreement between the “Parties”
 - d. As per TCIL EOI
17. Notices and other communications under this MoU shall be in writing and communicated through post, courier, fax, email or any other recognized mode of such communication. All such notices and communications shall be directed to the address as mentioned in the MoU.

18. By signing this MoU, the “Parties” acknowledge that it correctly records the understanding they have reached with regard to the Project.
19. EOI document, technical / financial bid, any further negotiations, all correspondences with or from _____ (vendor name) till EOI finalization shall be an integral of this MOU.

IN WITNESS WHEREOF, each party hereto has caused this MoU to be executed in duplicate to be effective as of the Effective Date, by its duly authorized representative.

(For Telecommunications

(For _____

Consultants India Ltd.)

Private Limited)

Signature:

Name:

Designation:

Date:

Witness:

Signature:

Name:

Designation:

Date:

Witness:

NOTE (For User Division):

The template of Pre-bid MoU documents [(1) with consortium, and (2) without consortium] are enclosed. Necessary changes/modifications as applicable should be made prior to floating in EOI/signing the MoU. The relevant MoU format may be made a part of EOI document, so that it can be signed on selection of vendor at pre-bid stage.

END OF SECTION-18 -



مطارات عُمان
Oman Airports

**OMAN AIRPORTS MANAGEMENT COMPANY
SULTANATE OF OMAN**

REQUEST FOR PROPOSAL

ITC-2308288

**DESIGN, ENGINEERING, SUPPLY, CONSTRUCTION, TESTING, COMMISSIONING
INCLUDING OPERATION AND MAINTENANCE OF 20MW MUSCAT INTERNATIONAL
AIRPORT & 6MW (SALALAH AIRPORT SOLAR PV PROJECTS ON ASSET LEASE BASIS
FOR FIXED TENURE**

TENDER DOCUMENT

OCTOBER 2023



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SECTION 01

INVITATION TO TENDER



1 INVITATION TO TENDER

OMAN AIRPORTS MANAGEMENT COMPANY S.A.O.C, (hereinafter called the “**Buyer**”) wishes to appoint a qualified **Contractor** to perform the following service:

**DESIGN, ENGINEERING, SUPPLY, CONSTRUCTION, TESTING, COMMISSIONING
INCLUDING OPERATION AND MAINTENANCE OF 20MW MUSCAT INTERNATIONAL
AIRPORT & 6MW (SALALAH AIRPORT SOLAR PV PROJECTS ON ASSET LEASE
BASIS FOR FIXED TENURE**

All as described in, and in accordance with the terms of the Tender Document, Tenderers must submit Both Technical and Commercial Offers As per the instructions To Tenderers article 2.12, labeled as follows:

ITC-2308288

**DESIGN, ENGINEERING, SUPPLY, CONSTRUCTION, TESTING, COMMISSIONING
INCLUDING OPERATION AND MAINTENANCE OF 20MW MUSCAT INTERNATIONAL
AIRPORT & 6MW (SALALAH AIRPORT SOLAR PV PROJECTS ON ASSET LEASE BASIS
FOR FIXED TENURE**

The Bid shall be submitted electronically through the portal using your company registered vendor account
- not later than the Tender Closing Date and Time given in the tender advertisement.

(OAMC working hours: Sunday-Thursday -7.30 AM- 15.30 PM)

For inquiries related to the tender, please contact the following e-mail:
oamctenders@omanairports.com, marwa.ma.almalki@omanairports.com

For inquiries related to the portal, please contact the following e-mail:
vendor@omanairports.com

The contents of this Tender Document may not be disclosed to any other employee of Buyer. All questions and answers will be shared with all Tenderers participating in this process. Any clarification /questions may be presented no later than 10 Days before the Tender Closing Date to allow time for distribution of answers to all Tenderers.

The Buyer is not bound to accept the lowest Tender and reserves the right to reject any or all Tenders without assigning any reason. Tenderers are responsible for dispatching their Proposals in sufficient time to allow ample margin for delayed delivery. Any Proposal received after Tender Closing Time will not be considered regardless of the cause of delay.

1.1 DEFINITIONS AND ACRONYMS

Both parties agree that the following words and expressions shall have the meanings hereby assigned to them, except where the context otherwise requires:

- | | | |
|-----|----------------------------|--|
| (d) | “Contract Price” | Means the Contract Sum adjusted to give effect to such additions or deductions as are provided for in the contract. |
| (e) | “Contract Sum” | Means the sum named in the Letter of Acceptance. |
| (f) | “Contractor’s Equipment” | Means all appliances or things of whatsoever nature required for the purpose of the Works but does not include Plant or other things intended to form or forming part of the Works |
| (g) | “Day” | Means calendar day. |
| (h) | “Defects Liability Period” | Has the meaning assigned by Clause 33.1 (Defects Liability Period). |
| (i) | “Drawings” | Means the drawings prepared by the Seller or by the sub-Contractor and made in accordance with Clause 5.2 (Drawings and Specifications). |
| j) | “Buyer” | Means the Oman Airports Management S.A.O.C. and the legal successors in title to the Buyer who will employ the Seller. The address of the Buyer shall, for the purpose of the Contract, be deemed to be as per that stated in the Form of Agreement. |
| (k) | “Engineer” | means <u>OAMC Engineer</u> or other person, persons or firm appointed from time to time by the Buyer and notified in writing to the Seller to act as the Engineer for the purposes of the Contract in place of the said Engineer whose full address in the Sultanate of Oman (including Registration Particulars) is : |



1.2 “VAT” means value added tax and includes without limitation goods and service tax, sales tax or any similar tax as applicable to the Agreement and the supplementary documentation issued thereunder, including but not limited to invoices, credit notes, debit notes and similar, in accordance with the prevailing laws of the Sultanate of Oman, including any transitional VAT legislative provisions.”

1.3 “Tax Authority” means the designated government agency that is responsible for managing, collecting and enforcing the relevant tax or any similar competent authority and relevant ministry under which it operates.

1.4 NOTE TO THE SUPPLIER:

Whilst the Performance Bond is an “On First Written Demand”, OAMC may, but is not bound to, adhere to the following procedure.

If, on the advice of the Engineer, OAMC considers that the Seller is in default of the due performance of his duties under the Contract, then OAMC will give fourteen (14) days written notice to the Seller of this occurrence during which time the Seller shall rectify such performance to the satisfaction of the Engineer.

If in the opinion of the Engineer such performance is not rectified, the Engineer shall inform OAMC accordingly in writing.

The aforementioned shall not, in any manner whatsoever, alter the nature of the “On First Written Demand” Bond.

SECTION 2

INSTRUCTIONS TO TENDERERS



2 INSTRUCTIONS TO TENDERERS

2.1 CURRENCY OF AGREEMENT

The currency of the Tender & the Contract shall be in the Rials Omani. Tenders submitted in foreign currency will be rejected.

2.2 DISCREPANCIES AND OMISSIONS

Should there be any doubt or obscurity as to the meaning of any of the Tender Documents, or as to anything to be done or not to be done under the Contract or as to these Instructions or as to any other matter or thing, Tenderers must set forth in writing such doubt or obscurity and deliver the same to the office as soon as discovered and in any case not later than two (2) weeks before the Tender Closing Date. If considered appropriate a reply in the form of a Circular Letter or Addendum will be distributed to all Tenderers to whom documents have been issued.

Any neglect or failure on the part of the Tenderer to obtain reliable information at the site or elsewhere that may affect the Tenderers ability to execute the Works and or deliver and install product as defined in the Scope of Work, or any other matters affecting the execution, completion and maintenance of the Works of this Contract shall not relieve the accepted Tenderer from any risks or liabilities or from the responsibility of completing and handing over the Works.

2.3 MODIFICATION TO TENDER DOCUMENT

The Buyer reserves the right to modify or amend any part of the Tender Document prior to the Tender Closing Date. These modifications, amendments and clarifications shall be issued as Addenda and/or Circular Letters to the Tender Documents. Tenderer shall confirm that Addenda and Circular Letters (if any) have all been considered in the Tender.

Addenda shall form part of the Contract and the Tenderer shall take into consideration the contents of such Addenda in his Tender. The Tenderer shall acknowledge receipt of such Addenda and Circular Letter by recording them in item 8 of the Form of Tender.

Buyer reserves the right to reduce the scope of the Contract in accordance with the Standard Conditions of Contract. Buyer also reserves the right to award the whole of the Contract to one Seller or to divide and award the Contract to more than one Seller.

2.4 SECRECY & CONFIDENTIALITY

Tenderer shall maintain strict secrecy and confidentiality in respect of all the information contained in this Tender Document.

During the Tender period, the Tenderer shall not communicate with anyone related to or deemed to be related to the preparation of the Tender unless expressly so directed by the Buyer or where such communication shall constitute an inquiry as set down hereunder.

2.5 LOWEST TENDER

The Buyer is not bound to accept the lowest Tender pricing and may cancel the Tender Document either partially or entirely without assigning any reason whatsoever. OAMC expressly reserves the unconditional right to reject any or all Tenders without being liable to give any reason whatsoever.

Buyer may invite the Tenderer to discuss and/or clarify the Tender, no such invitation or discussion shall in any way be construed as a commitment on the part of Buyer to award a Contract.

2.6 SIGNATURE OF TENDER

The Tender Documents shall be returned in the same form as issued and not rebound or rearranged in any way except as instructed herein. All requested documents, issued Addenda and Circular Letter (if any) should be submitted with the Tender. Except as otherwise expressly provided for in the Tender Documents, the Tenderer shall insert the requested documents detailed hereunder at the rear of the Prime Document; under no circumstances shall Tender Documents be otherwise altered or other documents inserted.

The Tenderer shall complete the Form of Tender, the Appendix to the Form of Tender, the Schedule of Prices and Appendices, if any, but not in the Form of Agreement and its Appendices, and standard Forms of Bond and shall sign, put the date and stamp all pages of the Tender Documents with the company's official stamp.

The Tender must be signed by the duly appointed principal fully authorized to represent and bind the Tenderer. Any incomplete or improper Tender will be rejected.

2.7 ALTERATION ON TENDER DOCUMENT

The Tenderer is not allowed to delete, modify or amend any of the items or conditions of the Tender Documents. If he desires to state any condition or reservations, he should enumerate them in a letter appended to his Tender, and refer to this letter in the Tender itself.

No alterations in the text of the Tender Documents shall be made except for the filling in the blanks intended to be filled up. Failure to fully comply with this instruction will result in the rejection of the Tender.

Any alteration to a unit rate or amount made by the Tenderer to correct clerical errors or illegibility entered by him in the Schedule of Prices during the preparation of the Tender must be initialed by the person authorized to sign the Tender prior to the submission of the Tender.

No alteration shall be made to the Specification and Schedules. The Tenderer is required to submit a Tender which fully complies with Tender Specification and a Tender which contains any departure from or qualifications to the Tender Specification will be rejected except as provided for hereinafter.



2.8 TENDER BOND

The Tenderer must submit, together with his Tender, a Tender Bond made in accordance with the following:

- a) A Tender Bond in the sum of not less than one percent (1%) of the total investment value, valid for ninety (90) days obtained from a locally registered Bank. If the Tenderer submits an alternative Tender, the one percent (1%) Tender Bond shall be calculated based on the highest investment value. The wording of the Tender Bond shall be as per the prescribed Form of Tender Bond included in this Prime Document.
- b) The Tender Bond of the unsuccessful Tenderers will be returned on its expiration or after the award of the Contract to the successful Tenderer.
- c) The Tender Bond of the successful Tenderer will be discharged after the Tenderer has signed the Contract and furnished the Performance Bond.
- d) The Tender Bond will be forfeited:

If a Tenderer withdraws his Tender during the period of Tender validity specified in the Tender documents; or

In the case of a successful Tenderer; if the Tenderer fails:

To sign the Contract; and/or to furnish the Performance Bond

2.9 PERFORMANCE BOND

The successful Tenderer will be required to provide a Performance Bond (as defined in THE CONDITION OF THE CONTRACT) to the value of five percent (5%) of the Contract Value, obtained from a locally registered Bank and valid for the whole of the Contract and Defects Liability Period. The Performance Bond will be retained by the Buyer during the Contract and Defects Liability Period and will be returned to the Seller upon the satisfactory completion of the Defects Liability Period.

Failure to execute the Contract and to provide a Performance Bond a month from letter of award cause the Tender Bond to be forfeited.



2.10 COMPLIANCE WITH STATUTORY REGULATIONS

The Tenderer shall conform to the Law of the Sultanate of Oman now in force or which may be made from time to time during the period of the Contract and such shall be the governing law.

All arrangements which effect the engagement, transport, paying, feeding and housing of labor and other matters in connection therewith shall be subject to the regulations and codes of the Sultanate of Oman now in force or which may be made from time to time during the continuance of the Contract.

2.11 TENDER SUBMISSION

Before submitting the Tender, the Tenderer shall read the Tender Documents carefully and satisfy himself of the tasks, risks, obligations, liabilities and responsibilities to be undertaken in the Contract. The Tenderer shall acquaint himself with the Conditions of Contract, the Laws of the Sultanate of Oman, the site of work, and specification of the equipment specified in the Tender Documents.

The Tenderer is required to submit his offer in two volumes:

Volume 1:

A soft copy of the Technical Proposal in a Zipped folder,

Volume 2:

A soft copy of the signed Financial Proposal in a Zipped folder including scanned copy of the Tender bond.

Note that the original bond to be submitted in sealed envelope to the Contracts and Procurement Department, Level 01, South Forecourt, addressed to:

The Chairman of Minor Tender Committee
Oman Airport Management Company S.A.O.C
New Muscat International Airport
Postal Code 111, Sultanate of Oman

- -The exterior of the envelope should be labeled with Tenderer name, Tender Title and Tender Ref. No.
- The submission of the original tender bond shall be within 3 working days after the electronic submission only.
- All files to be in PDF format only or as instructed in the tender documents.

Explanation of Submission Strategy Mode:

1. If Submission strategy selected is **Combined mode**:

Both volumes 1 & 2 to be zipped in one Main zipped folder and submitted all together.

2. If Submission strategy selected is **Separate mode**:

Both volumes 1 & 2 to be zipped in two zipped folder and submitted separately.



3. If Submission strategy selected is Technical only **mode**:

Only Volume 1 to be zipped and submitted accordingly

4. If Submission strategy selected is Commercial only **mode**:

Only Volume 2 to be zipped and submitted accordingly

The Technical Proposal shall contain all the required documentation requested in the Tender Documents and shall exclude any information of a financial nature. All submissions of a financial nature shall be presented in the Financial Proposal. Details of contents for both Technical and Financial proposals are presented in Section 5 of this Prime Document.

The sealed bids shall be delivered as specified in the letter of Invitation to Tender or at such other time and date as notified by any Circular or Addendum issued to Tenderers.

The attention of the Tenderer is drawn to the fact that the Tender must be delivered as per the submission strategy mode described in the article and that the Tenderer is responsible for ensuring that any opening of parcels containing Tender Documents, Technical Proposals and Financial Proposals for custom and security reasons is made good before delivery to the Buyer.

Buyer may, at its discretion, extend the Tender Closing Date by amending the Tender Documents and in such case, all rights and obligations of Buyer and the Tenderer previously subject to the old Tender Closing Date will thereafter be subject to the Tender Closing Date as extended.

The Tenderer may modify or withdraw his Tender after Tender submission, provided that the modification or notice of withdrawal is received in writing by the Buyer prior to the Tender Closing Date.

The Tenderer's modification or notice of withdrawal shall be prepared, sealed, marked and delivered in accordance with this Clause, with the envelope additionally marked "MODIFICATION" or "WITHDRAWAL" as appropriate.

Withdrawal of a Tender during the interval between the Tender Closing Date and the expiration of the period of Tender validity may result in the forfeiture of the Tender Bond.

Any Tender received by Buyer after the Tender Closing Date will be rejected whatever caused the delay.

The Tenderer shall note that the evaluation of the Tenders shall be based on two criteria; these being:

- Technical Proposal; and
- Financial Proposal.

2.12 NO ADJUSTMENT OF UNIT RATES

The attention of the Tenderer is drawn to the fact that the Contract does not include provisions for currency fluctuation. The Tenderer must include in his rates and prices an allowance for any possible increases in the cost of labor, materials and plant & equipment which may occur during the period of the Contract except for increases which may be a reimbursable in the Conditions of Contract.



The rates and unit prices set down against the items in the Schedule of Prices shall be for the full inclusive value of the Works described including import duties, taxes, levies, overheads and profit, and all obligations and liabilities of every kind arising under the Contract.

2.13 TENDER WITHOUT QUALIFICATION

The Tender shall be submitted solely on the basis of the Tender Documents issued to the Tenderer and must be free of any qualification. Should the Tenderer wish to submit an alternative offer, such offer must be additional to and completely separate from the unqualified Tender.

2.14 ADDITIONAL DOCUMENTS

In addition to the Tender Documents issued for Tendering, it is mandatory for the Tenderer to provide and properly bind under the “Tenderer’s Enclosures” section of the Prime Document, the following documents. Any Tender not accompanied by all the required documents might be rejected.

- a) A copy of each Circular Letter and Addendum, if any, issued by the Buyer, appropriately endorsed by the Tenderer.
- b) A list of delivered Projects where similar Products have been supplied, together with quantities and value indicating those which are contracted before and at the time of tendering and are expected to be delivered; and those which are to be performed inside and outside of the Sultanate of Oman
- c) A list of any proposed Agents, sub-Agents and Spare Part Traders/Agents, including local firms, with particulars of the extent of the work, which it is proposed will be undertaken by them. Preferential consideration shall be given to the Tenderer who is offering a high proportion of local specialized subcontractors, local materials, and Omani labor obtained from the region where the project is to be executed.
- d) A statement of the Tenderer’s financial standing, including the name and address of his banks, together with the authority to approach his bankers for relevant information and comment.
- e) A list of the manufacturer’s recommended spare parts and special tools giving description, numbers and unit price as required by the specification. In addition, a list of all procured material spares as per the relevant Specifications shall also be provided (if applicable). The above list shall itemize all replaceable and repairable parts/units respectively that may be required after specific periods of operation. The Tenderer shall justify the recommended spares based on MTBF (Mean Time between Failures) calculations and field experience.
- f) A statement of unresolved doubts regarding the meaning of anything contained within the Tender Documents and the interpretation relied upon by the Tenderer.
- g) A copy of valid Oman Tender Board registration (if available).
- h) Computer printout document issued by Ministry of Commerce and Industry containing the name(s) of the owner(s) of the Tenderer with specimen signature(s) (for all local Tenderers).



- i) Full and valid registration documents issued by the Ministry of Commerce and Industry and Tender Board in the specified category and grade for Omani Joint Venture Company and Sub-contractors if any.
- j) Details of National Standards or Codes of Practice which the Tenderer proposes as alternative to standards mentioned or implied in the Tender Documents.
- k) A statement giving a confirmation that the Tenderer shall employ a Minimum Percentage of Omani employees in this project as per Regulations and Codes issued by the Ministry of Manpower. However this not applicable for supply services, which have a limited period for delivery of their scope.
- l) The proposal for providing offices for the Buyer and separate Seller's staff and labor force, workshops, etc. together with the layouts location and areas of land for the provision of such facilities (if applicable).

2.15 TRADE NAMES, MANUFACTURER'S NAMES AND MODEL NUMBERS

The Tenderer shall disregard all manufacturers, trade names or brand names, model numbers and foreign certification marks that may appear in the Tender Documents. Kite mark and other foreign certification marks and certification for materials and equipment required from Original Equipment Manufacturers (OEM) are not permissible in this Agreement.

2.16 TENDER PRICES AND VALIDITY

The Tenders shall remain valid for acceptance for one hundred eighty (180) days from the date fixed for submission of Tenders. The Buyer reserves the right to ask the Tenderer for extension of the validity of his Tender and Tender Bond without any changes in the prices of the Tender. The Tenderer may refuse to extend the validity of his Tender without forfeiting his Tender Bond. A Tenderer that agrees to the request will not be required nor permitted to modify his Tender.

Labor, materials, handling, transport, loading, unloading, installation or any other factors affecting prices of services, shall be included in the quoted prices. The prices shall cover all the Works pertaining to this Supply and Installation Contract.

The total prices quoted by the Tenderer shall include without limitation the following:

- a) Cost of visiting the project site to familiarize themselves of site layout and logistics for supply and installation. The Tenderer shall arrange access, HS&E and any other relevant issues which may affect this Tender.
- b) All expenses for royalties, licenses, custom duties, taxes and the like in connection with the Works.
- c) Cost of provision of a Defects Liability Guarantee in the accordance with the Contract commencing from the date of handover to the Buyer and accepted by the Buyer.
- d) Certificate of Completion / Acceptance that the works have been completed and accepted by the buyer as being complete
- e) Cost of supply, storage, shipping, transport, housing and the like, where applicable.



2.17 NATIONAL AND INTERNATIONAL STANDARDS

National Standards shall where relevant take precedence over international standards where relevant in the specification of materials, equipment, and workmanship for the Works. Reference numbers of national and international standards such as OS, BS, ASTM, etc. referred to in the Tender Documents shall mean the latest revision of such standard current at the time of Tender.

2.18 CORRECTION OF ERRORS

The Schedule of Prices will be examined prior to the signing of the Contract in order to ascertain that the items are correctly extended at the rates quoted. Should any arithmetical errors be found, it will be corrected and the bidders Tender Sum will be amended accordingly. The Tenderer will be informed of any arithmetical adjustment made should the Buyer wish to further consider his Tender.

Arithmetical errors will be corrected on the following basis: If there is a discrepancy between the unit rate or price and the total price that is obtained by multiplying the unit rate and quantity, the unit rate or price shall prevail and the total price shall be corrected. If there is a discrepancy between words and figures, the amount in words will prevail.

2.19 POST TENDER CLARIFICATIONS

To assist in the examination, evaluation and comparison of Tenders, the Buyer may ask Tenderers individually for clarification of their Tender, including breakdown of unit rates. The request for clarification and the response shall be through the portal only, but no change in the price or substances of the Tender shall be sought, offered or permitted, except as required to confirm the correction of arithmetical errors discovered during the evaluation of the Tenders.

Post Tender Clarifications do not constitute intent to award or an award of the Contract. However, in the event that the Tender is accepted, Post Tender Clarifications and their related answers will form part of any subsequent Contract as part of the applicable Contract Documents stated herein.

2.20 COSTS OF TENDERING

The Tenderer shall bear all costs associated with the preparation and submission of his Tender, in visiting the Site and obtaining information necessary for preparing and submitting his Tender. The Buyer will in no case be responsible or liable for all costs associated with the Tender, regardless of the outcome of the tendering process.

2.21 LOCAL TAXES AND CHARGES

All local taxes, income tax, VAT, port dues, landing charges and local transportation charges and all other levies or dues, as per the Law in force in the Sultanate of Oman during the Contract Period shall be borne by the Tenderer, and his Tender shall be deemed to have included all such charges.

2.22 ACCEPTANCE OF TENDER INVITATION

Unless otherwise stated in the Tenderer's covering letter or in his response to the Tender invitation, the participation in this Tender shall mean that the Tenderer understands and accepts all conditions laid down in the Tender Documents.



It shall also mean that he accepts the responsibility to undertake the Contract based upon the Scope of Supply, BOQ & Technical Specifications outlined in the Tender Documents and the subsequent modifications agreed to between the Tenderer and Buyer.

2.23 TENDERER'S BREAKDOWN OF UNIT RATES

The Tenderer shall be required to provide a detailed analysis of the unit rates or prices entered by him in various items of the Schedule of Prices when requested in writing by the Buyer during Tender evaluation.

Any efforts by the Tenderer to influence Buyer in the process of examination, clarification, evaluation and comparison of Tenders, and in decisions concerning awarding of Contract, will result in the rejection of the Tenderer's Tender.

2.24 GOVERNING LAWS

The Tenderer is obligated to familiarize himself with local laws and shall conform to the Laws of the Sultanate of Oman. The Laws in the Sultanate of Oman now in force which may be made from time to time during the period of the Contract shall be governing laws as per Condition of the Contract.

2.25 EVALUATION PLAN

Tenders will be checked and evaluated in accordance with the procedures outlined in Section 7 of this Prime Document.

2.26 DEVIATIONS

The supplier shall fill the attached deviations from

2.27 SAFETY

The Seller shall conform to all safety rules, regulations and instructions issued by The Buyer, including The Contractor's Security Policy, and the OAMC HSE plan for delivery, or installation to site or operational airport as defined in attachments to this Tender Document.

The Tenderer shall provide a statement as to safe working practices and how he proposes to ensure the safety of his workers, equipment and other users of the Airport.

2.28 INSURANCE

The successful Tenderer will be required to insure the Works to be supplied with insurance companies registered in the Sultanate of Oman or as per Conditions of Contract. When required, Buyer will provide Third Party Airside Liability Insurance cover on behalf of the Seller at no cost to the Seller.

2.29 PROVISION OF SOFT COPIES OF ALL DOCUMENTS

All Tenderers shall ensure that all copies are submitted electronically through the portal within their Tender submission mode in PDF format for both the Original documents and the Copy documents. Soft copies shall contain all correspondence, circulars and addenda. Failure to supply this may result in disqualification of the Tender, or adversely affect the evaluation criteria score.



2.30 Quality of Goods and Delivery

The Quantities mentioned below hereof are provisional. The Client may, during the tenure of the Contract, order goods fully, partly or not at all at the direction and discretion of the Client and the Supplier shall Supply and Deliver the ordered goods in accordance with this tender. Goods shall be delivered upon receipt of an written order to this effect from Admin Department of Oman Airports within the Delivery Period as stipulated hereof goods are to be delivered packed and clean without any damage and before the expiry date for consumable items.

2.31 Instruction to Bidders

- The Bid submission must be in English
- Bidder must bid for total capacity and cannot choose for bidding for individual projects i.e., Muscat & Salalah
- Bidder will set up the Solar PV Project on a fixed lease basis which will be signed with OA
- Such fixed lease fee shall not change for the entire tenure of the lease, regardless of the annual tariff or units generated by the solar PV plant
- Bidder must raise any queries during any stage of the bidding/evaluation as per Annexure – Bidder's Queries Format
- Bidder must follow APSR Solar Lease Guidance document issued by APSR, prevalent at the time of submitting their bid. Current guidance document is annexed as Annexure - APSR Solar Lease Guidance
- Bidders must consider FAT (Factory Acceptance Test) for OA personnel (up to 3 personnel) to visit major components manufacturers
- Successful bidder will sign a Lease agreement with OA, which shall be agreed mutually between OA and successful bidder.
- In case the bidder fails to meet its obligations/forecasted generation, the OA may penalize the bidder by a fixed percentage or a fixed amount of money. Such clause, termed as Annual Performance Clause, will form part of the lease agreement, and will be mutually agreed by OA and successful bidder.

Note:

Clearly note that the successful bidder is not allowed to sublet/ sub-contract entire scope of service to any other contractors. Only design and engineering as a part of work/ service would be allowed to sublet post approval of the sub-letting company credentials from OA.

2.32 CLARIFICATION OF BIDS

During evaluation and comparison of bids, OA may, at its discretion ask the bidder or clarification of its bid. The clarification should be received within 3 business days from the bidder from date of receipt of such request. The request for clarification shall be in writing and no change in prices or substance of the bid shall be sought, offered or permitted. No post bid clarification at the initiative of the bidder shall be entertained.



2.33 CONFIDENTIALITY

Except as required for the preparation of a response, the Bidders must not, without OA prior written consent, disclose to any third party any of the contents of the RfP documents or subsequent information and documents provided by OA. Bidders must ensure that their employees, consultants, and agents also are bound and comply with this condition of confidentiality.

2.34 ASSET RELATED GUIDANCE

- Bidder must ensure that the Solar PV Plant is set up in technical & commercial compliance to APSR, OETC, NED (for Muscat Project), NDSC (for Salalah Project) and CAA (for both projects).
- Bidders to note that OA has obtained NoC from CAA for the selected land parcels. The PV Array boundary limit of such parcels including the tilt and azimuth are provided in the Project Information Note (PIN). However, Bidders must conduct their own due diligence and independent Anti-Glare Study to ensure compliance with CAA requirements as stated in their letters.
- Bidder must start supply of electricity to OA in Nine (9) months from Letter of Award (LoA).
- Bidder will be required to clearly demarcate the Asset Boundary by appropriate fencing and dedicated Access Road.
- Bidder must ensure that the infrastructure setup by the bidder is self-sufficient for the operation of the asset and no dependency on OA (except land) shall be provisioned. This includes any modifications in existing infrastructure at the interconnecting substation, which the bidder has to execute with prior permission of OA.
- Bidder must understand that the project is being set-up in close proximity to Airport Operations which form part of the critical infrastructure of the country. Bidder must plan and execute all phases of the project, throughout the lease tenure, strictly ensuring no interruptions to the principal business activities of OA. Any work to be performed must comply to HSE and other guidelines laid out by OA from time to time. The bidder must understand that any interruptions to OA's electrical and communications network or principal operations shall invite Business Interruption Penalty and the same shall be appropriately worded and covered in Lease agreement.
- Bidder must guarantee a plant uptime of 99% and the same shall be reflected in the declared Energy Forecast Schedule. No additional downtimes shall be allowed during generation hours. Any planned maintenance to be done by the bidder shall be undertaken in non-generation hours with a Three (3) day prior notice to OA's concerned department and their approval.



SECTION 03

STANDARD TERMS AND CONDITIONS



3 STANDARD TERMS AND CONDITIONS

Bidder shall submit the contractual agreement on the basis of BOOT agreement



SECTION 04

SCOPE OF WORKS



4 SCOPE OF WORKS

4.1 ABBREVIATIONS

APSR	Authority for Public Services Regulation
CAA	Civil Aviation Authority
NDSC (formerly DISC)	Nama Dhofar Services Company (formerly Dhofar Integrated Services Company)
EPC	Engineering, Procurement & Construction
HSE	Health Safety & Environment
KPI	Key Performance Indicators
kV	Kilovolt, a unit of potential difference equal to 1000 volts.
MCT	Muscat
NED (formerly MEDC)	NAMA Electricity Distribution (formerly Muscat Electricity Distribution Company)
MW	Megawatt, a unit of power equal to one million watts
MW AC	Sum of rated capacity of inverters in Megawatt
MW DC / MWp	Sum of installed capacity of Solar Modules in Megawatt
OA	Oman Airport
OEM	Original Equipment Manufacturer
OETC	Oman Electricity Transmission Company
PIN	Project Information Note
PV	Photovoltaic
RfP	Request for Proposal
SLL	Salalah

4.2 PROJECT BACKGROUND

As a part of its **energy transition drive** towards renewable energy to be strategically in line with Oman Vision 2040, targeted to tackle climate change, and carbon foot print accreditation, the senior management of **Oman Airports Management Company (OA)** desires to develop and implement strong corporate Key Performance Indicators (KPI's) such as the introduction of energy saving initiatives in daily operations and to shift from conventional GRID electricity power to Renewable Energy Sources.

In view of the same, OA has issued this Request for Proposal (RfP) to bidders wishing to participate in a Competitive Procurement Process leading to Asset Lease Basis agreement for fixed tenure for **“Design, Engineering, Supply, Construction, Testing, Commissioning including Operation and Maintenance of 20MW (Muscat) & 6MW (Salalah) Solar PV Projects on Asset Lease Basis for a fixed tenure.”**

The power generated from the proposed Solar Project will be injected in 11kV internal distribution feeders of respective Airport in compliance with main grid electrical power supply parameters like voltage, frequency, power factor, etc. while ensuring Zero Export to Grid (Reverse Power Protection) at Grid Incomer of 132kV.

Projects will be installed and operated in compliance with guidelines published from time to time by the Authority for Public Services Regulation (APSR), Oman Electricity Transmission Company (OETC), NAMA Electricity Distribution (NED) (formerly Muscat Electricity Distribution Company (MEDC), Nama Dhofar Services Company (NDSC) (formerly Dhofar Integrated Services Company, DISC) and Civil Aviation Authority (CAA).

The location of site to develop the proposed Solar PV power plant is selected based on the feasibility study conducted by OA. Key parameters are tabulated below:

Airport	Type	Estimated AC Capacity	Estimated DC Capacity	Estimated Area	Inter-connection
Muscat (MCT)	Ground Mount	20 MW	24.1 MWp	2,81,540 sqm	11kV MCT Network
Salalah (SLL)	Ground Mount	6 MW	7.2 MWp	99,876 sqm	11kV SLL Network

Land for setting up the projects will be free issued to the Project Developer i.e. no usufruct charges to be paid to OA. Land Shape/Area is attached as **Annexure – kmz file for MCT and SLL** and bidders must follow the same, since CAA NoCs have been issued based on Solar PV Array placed in these areas respectively at MCT & SLL.

The procurement process will be formed of several steps, with this RFP forming step one. The indicative procurement timeline for the Project is as mentioned in the below table:



Tender Timetable

S. No.	Description	Date
1	Issue of RfP Tender Document	02 nd October 2023
2	Tendering Period	21 days
3	Site Visit by Bidders (on request)	Muscat: 10 th October 2023 Salalah: 11 th October 2023
4	Pre-bid Queries by Bidders	11 th October 2023
5	Bid Submission End Date	23 rd October 2023
6	Bid Opening Date	24 th October 2023
7	Bid Evaluation Completion	TBC
8	Lol Issuance to Finalized Bidder	TBC
9	Work Award Date & Contract Execution	TBC

Note : above timetable is an estimate and can be adjusted .

4.3 SCOPE OF WORK

- Turnkey Engineering Procurement Construction (EPC) Services including Design, Engineering, Supply, Construction, Testing, Commissioning & Synchronization of the projects at MCT & SLL on Asset Lease Basis for a fixed lease tenure.
- **Technical Specifications**, Requirements and **Method Statement** form an integral part of this RfP. The guidelines laid out in these documents as part of RfP must be complied with by the Bidder.
- Comprehensive Operation and Maintenance of Solar PV Projects for the lease tenure.
- All related and applicable approvals required from time to time from statutory and non-statutory bodies prior to, during, and after construction of the projects.



4.4 QUALIFICATION REQUIREMENT

Interested companies meeting the following criteria should respond to this RfP along with all the required documents:

Eligibility Criteria (Go/No-Go):

1. Bidder to submit Signed & Stamped Tender & it's Appendixes
2. Bidder to submit Signed & Stamped Copy of all addendums and circulars issued
3. Confirmation of site knowledge
4. Detailed Company Information including commercial registrations.
5. Bidder to submit the Power of Attorney in favor of its representative as evidence of Authorized Signatory's Authority as per **Annexure – Format for Power of Attorney**
6. Positive EBITDA in each year of the immediately preceding two (2) financial years (FY 2021 and FY 2022).
7. Minimum Annual Average Turnover in each of the immediately preceding Two (2) financial years should be equal to or more than USD 20 million per year for bidder/lead bidder
8. Minimum net worth of the company should be equal to or more than USD 50 million
9. Bidder must furnish declaration as per **Annexure - Financial Criteria Qualification of the Bidder**
10. Company's financial performance documents (Audited Balance sheets and Profit and Loss statements, Auditors Report and Notes to Accounts etc.) for last Three (3) financial years. Latest financial statement should not be older than 18 months on the date of submission of response to RfP.

Note:

- i. Normally standalone financials of the bidding entity only will be considered. However, consolidated financials at the bidding entity level, if available, can also be submitted. Parent company or Affiliate's financials can be submitted and considered, subject to submission of Parent/ Affiliate company guarantee. This should be clearly mentioned in the bidders response.
 - ii. Evaluation will be done only based on the published annual reports/ audited financials containing Auditor's report, Balance sheet, Profit & Loss a/c and Notes to Accounts.
 - iii. In case of unaudited statements (if there are no audit requirements for auditing of financials as per the local law), the financials shall be accompanied by a certificate from a Certified Accountant. The Certificate should also mention the fact that there is no requirement of audit of the financials as per the local law.
11. Bidder must submit their applicable Credit rating report
 12. Bidder must submit their funding strategy
 13. Bidder must submit financials of the project
 14. Possession of licenses for the regulation authorities

15. Manufacturer Support letter

OA will evaluate the bids based on Evaluation Criteria prescribed in this RfP, which covers the following submissions. Bidder to refer to the Evaluation Criteria section of this RfP for scoring and weightage of each submittal.

Technical Submissions:

1. Proof of successful completion by the tenderer a developer of having successfully constructed PV Plants and its PV Facilities with more than 15 MWac capacity. Bidder must have delivered two such projects.

For the project being admitted by the bidder as it's qualifying project, the following documents are to be submitted
 - a. Unpriced Purchase Order / Power Purchase Agreement / Lease Agreement / O&M Agreement, as applicable for the said project
 - b. Detailed scope of work for the said project
 - c. Purchaser's Signed Work Completion/Satisfaction Certificate for the said project
 - d. Predicted vs Actual Generation profile (monthly) for the operational history of the project or 2 years, whichever is lower (preferably purchaser certified)
2. Project Delivery Schedule (Official letter to be submitted with the offer) including Project Program Gantt Chart with detailed milestones
3. In-house Technical Team Capability (resume for key personnel must be submitted). Bidder to also provide organization structure and the team structure proposed for said project
4. Bidders QA/QC & HSE Plan must be submitted
5. Project Method Statements
6. Filled and Stamped BoQ

Commercial Submissions:

1. Bidder to specify monthly lease amounts specifically for Muscat & Salalah and lease tenure being offered in **Annexure – Lease Options Offered**.
2. Bidder to specify energy forecast for 25 years specifically for Muscat & Salalah as per the format prescribed under **Annexure – Energy Forecast Schedule**. Bidder shall be willing to guarantee such energy forecast as it will be incorporated appropriately in the finalized lease agreement. Bidder to submit PV Syst Simulation Report and Module OEM's degradation chart along with their bid in support of the Energy Forecast Schedule.



3. Draft Lease agreement in line with APSR guidelines applicable at the time of submission of bid to be submitted.

Other Submissions:

1. Any deviations/variations/exceptions being sought by bidder must be brought to light in format prescribed under **Annexure – Declaration of Compliance and Deviation Schedule**
2. Solar PV Plant (asset) will be transferred to OA after lease tenure without any transfer charges. This shall be in line with **Annexure - Asset Transfer Mechanism Post Lease Tenure**
3. Bidder to provide their tentative Bill of Quantities as per **Annexure – Bill of Quantities**
4. Bidder to provide declaration stating understanding of CAA NOCs issued individually for MCT & SLL for the said project and compliance to the requirements mentioned therein. The subject CAA NoCs issued for MCT & SLL are both attached as part this RfP as **Annexure – CAA NoCs**. This declaration shall be provided by bidder as per **Annexure – Compliance to CAA No Objection Certificate Requirements**
5. Copies of Valid Quality Certifications/ Accreditations (Example: ISO 9001, OHSAS 18001) or any other certification as applicable.
6. Covering Letter as per **Annexure – Summary of Bid**

ICV Elements

Bidder shall provide a detailed ICV plan consisting of the following elements:

1. To provide a recruitment plan for a number of nationals technicians & engineers.
2. To provide training for Oman Airports staff as well as for graduates.
3. To purchase made in Oman goods where applicable for the project and SCM will attach the OIA mandatory list.
4. To use local service providers.
5. To give work opportunities for SMEs.



SECTION 05

BILL OF QUANTITIES



5 Bill of Quantities

For BOQ refer to Appendix (A)



SECTION 06

FORMS



6 FORMS

- FORM OF TENDER
Appendix to Form of Tender
- FORM OF AGREEMENT
 - Appendix A- Bill of Quantities
 - Appendix B-Method of Statement
 - Appendix C-Annexures Combined
 - Appendix D- Annexure kmz file for MCT and SLL
 - Appendix E- APSR Solar Guidance
 - Appendix F-Health & safety Guidelines
 - Appendix G- OIA Mandatory List
 - Appendix H- CAA NOC's for Muscat and Salalah Airports
- FORM OF TENDER BOND
- FORM OF PERFORMANCE BOND



SHORT DESCRIPTION: DESIGN, ENGINEERING, SUPPLY, CONSTRUCTION, TESTING, COMMISSIONING INCLUDING OPERATION AND MAINTENANCE OF 20MW MUSCAT INTERNATIONAL AIRPORT & 6MW (SALALAH AIRPORT SOLAR PV PROJECTS ON ASSET LEASE BASIS FOR FIXED TENURE

FORM OF TENDER

(Note: The Appendix forms part of the Tender. Tenderers are required to complete all the blank spaces in this Form of Tender and Appendix).

To: **THE CHAIRMAN MINOR TENDER COMMITTEE**
OMAN AIRPORTS MANAGEMENT COMPANY
NEW MUSCAT INTERNATIONAL AIRPORT
POSTAL CODE 111
SULTANATE OF OMAN

Gentlemen,

1. Having examined the Instructions to Tenderers, Drawings, and Outlined Scope Of Supply, BOQ & Technical Specifications, Standard Conditions of Contract, Outline Specification and Schedule of Prices for the execution of the above-named Works, we, the undersigned, offer to execute, complete and maintain the whole of the said Works in conformity with the said Instructions, Standard Conditions of Contract, Outline Scope of supply and Schedule of Prices for the sum of Rials Omani.....
.....
(RO.....) and/or the sum of
.....
[] or such other sum as may be ascertained in accordance with the said Conditions.
2. We undertake if our Tender is accepted to commence the Works from the receipt of the Order to Commence, and deliver the whole of the Works comprised in the Contract within Nine (9) months from date of agreements.
3. If our Tender is accepted, we will obtain the undertaking of a locally registered Insurance Company or Bank as required in the Sultanate of Oman Standard Documents, to be jointly and severally bound with us in the sum of 5 percent (5%) of the Contract Sum for the due performance of the Contract under the terms of a Performance Bond to be approved by you.



4. We agree to abide by this Tender for a period of one hundred nighty (90) days from the date fixed for receiving the same and it shall remain binding upon us and may be accepted at any time for the expiration of that period.
5. In the event of our Tender being accepted and until a formal Agreement is prepared and executed, this Tender, together with your written acceptance thereof, shall constitute a binding obligation upon us.
6. We understand that you are not bound to accept the lowest or any Tenders that you may receive.
7. We understand and agree that we will be evaluated in accordance to the Evaluation Plan stipulated in this Tender.
8. We acknowledge receipt of the following circular letters/addenda:-
- 9.

Reference Number	Date
.....
.....
.....
.....

9. We confirm that we have established an internal project management team to liaise with the Buyer to ensure delivery of the foresaid Works and meeting the time, quality & cost targets:

Name of manager_____

Mobile number_____

Name of supervisor_____

Mobile number_____

10. We confirm that in accordance with Oman Investment Authority Policy (OIA) that the following persons/shareholders of the Company have an interest in the Tender

NAME	INTEREST
_____	_____
_____	_____
_____	_____



FORM OF TENDER BOND

**Oman Airports Management Company
S.A.O.C P.O. Box 1707,
Muscat International Airport
Postal Code 111 Sultanate of Oman**

Tender Bond No. _____

By this bond we, _____,

whose address is _____,

hereby guarantee Messrs. _____ of
_____, and hold at your
disposal the sum of Rial Omani (R.O.) _____, and/or
_____ being _____% of the required Tender Sum
from _____ until _____, a total period of ninety (90) calendar days.

This bond shall be free on interest and payable in cash on your first written demand in the event of the Tenderer either withdrawing his Tender within a period of ninety (90) calendar days from the date of the receipt of Tenders or failing to provide a Performance Bond within ten (10) calendar days for local Sellers or twenty (20) calendar days for international Sellers, of acceptance of the Tender without any reference to or contestation on behalf of the Seller.

This bond shall be returned to The Seller or the Bank upon its expiry or upon fulfilment of our undertaking whichever shall be the earlier.

Authorized Signature

(to be issued by locally registered bank or Insurer)



FORM OF PERFORMANCE BOND

Oman Airports Management Company S.A.O.C
P.O. Box 1707, Muscat International Airport
Postal Code 111 Sultanate of Oman

Performance Bond No.....

Whereas

.....(herein
after called the “Seller”) has been awarded a Contract datedto execute, complete and remedy the
defects of the **DESIGN, ENGINEERING, SUPPLY, CONSTRUCTION, TESTING,
COMMISSIONING INCLUDING OPERATION AND MAINTENANCE OF 20MW MUSCAT
INTERNATIONAL AIRPORT & 6MW (SALALAH AIRPORT SOLAR PV PROJECTS ON
ASSET LEASE BASIS FOR FIXED TENURE**

..... for the value of R.O

..... (Rials Omani)

.....and/or.....

..... by

this bond we,

..... whose
address is are held and firmly
bound unto the Oman Airports Management Company (OAMC) Muscat, Sultanate of Oman in the sum of R.O.

..... and/or

..... being five percent (5%) of the Contract Sum.

We agree to make unconditional payment under this bond on your first written demand without any reference to or
contestation on behalf of the Seller provided the claim is received by us on or before

.....

The bond will be effective fromand shall be valid until the
.....after which date our liability shall automatically cease.

The bond should be returned to us upon its expiry or upon fulfilment of our undertaking whichever is the earlier.

Authorized Signatories

(To be issued by a locally registered bank)



NOTE TO THE SELLER

Whilst the Performance Bond is an “On First Written Demand” Bond, Buyer may, but is not bound to adhere to the following procedure. If Buyer considers that the Seller is in default of the due performance of his duties under the Contract, then Buyer will give fourteen (14) days written notice to the Seller of this occurrence during which time the Seller shall rectify such performance to the satisfaction of the Buyer.

If in the opinion of the Buyer such performance is not rectified, the Buyer shall inform the Seller accordingly in writing.

The aforementioned shall not, in any manner whatsoever, alter the nature of the “On First Written Demand” Bond.



TENDERER'S ENCLOSURES

The Tenderer shall properly bind in after this page the supporting documents required by Clause 3.15 of the "Instructions to Tenderers". All documents shall be endorsed with the Tenderer's official company stamp. Any Tender not complying with this instruction, may be rejected.

The Tenderer's submission shall include, but not be limited to, the following:

TECHNICAL PROPOSAL:

- PERFORMANCE RECORD
- STATUS OF CERTIFICATES
- PROJECT DELIVERY SCHEDULE AND PROCESS METHODOLOGY
- QUALITY MANAGEMENT SYSTEM
- SCHEDULES (see forms below):
- SCHEDULE A: DEVIATIONS FROM TENDER CONDITIONS
- SCHEDULE B: TECHNICAL GUARANTEED PARTICULARS
- DOCUMENTS REQUIRED BY CLAUSE 3.15 (see above)
- OTHER DOCUMENTATION AS REQUIRED AS PER SCOPE OF WORKS,

FINANCIAL PROPOSAL

- THIS PRIME DOCUMENT (with filled Form of Tender and filled Appendix to Form of Tender)
- FORM OF TENDER FILLED FOR EACH PROPOSAL OPTION
- BIDDING FORM FOR NON-CONFLICT OF INTEREST DECLARATION
- BILL OF QUANTITIES FILLED FOR EACH PROPOSAL OPTION
- PARTICULAR TERMS AND CONDITIONS OF SUPPLY (if applicable)



PERFORMANCE RECORD

The Tenderer shall submit their experience and performance record as below:

- Company profile
- Business scope
- Date of establishment of the company
- General experience of Projects of same nature executed (Include total number of years)
- Detailed list of similar works completed from the year the company was established including on-going projects with amount of each project (list of buyers per year)

The Tenderer shall state below his experience with works similar to that which is included in this Tender. The statement shall include the experience as a principal seller related to similar work, the place and date of completion of such similar works, and the agency for which they were undertaken.

Authentic certificates of good performance of contract in which similar works were completed might be submitted to support this statement.

Name of Project	Name of Buyer	Place	Quantity or Volume of Work	Duration of Contract (Planned / Actual)	Value of Contract

Note: Tenderer shall provide additional sheets if necessary.



STATUS OF CERTIFICATES

The Tenderer shall give below the details of the status of every certification required or related to the execution of the Project.

This shall include, but not to be limited to, kinds of certificate, certified by/certifying body, quantity of holders, and experience with the certificate, etc.

Certificates	Certified by	Quantity of holders	Ratio (%) (if applicable)

Note: Tenderer shall provide additional sheets if necessary.



PROJECT MASTER SCHEDULE AND PROCESS METHODOLOGY

The Tenderer shall give the details and other pertinent information of his technical planning to perform the Contract to meet Buyer's satisfaction in timely and good quality manner.

The minimum specification or general plan to be included:

- Detailed methodology, sequence and program/manner of delivery of installation of the works.
- Project master plan and each process to be executed for the works

Note: Tenderer shall provide additional sheets if necessary.



QUALITY MANAGEMENT SYSTEM

The Tenderer shall give the details and other pertinent information of his technical planning to perform the Contract to meet Buyer's satisfaction in timely and good quality.

The minimum specification or general plan to be included:

Quality Management Plan

Tenderer shall submit the relevant document and certificate including QA/QC management system and organization, ISO 9000 /ISO9001/ISO14000 and other relevant certificate, business license including QC plan of project, QC standard manuals, etc.

Note: Tenderer shall provide additional sheets if necessary.



SCHEDULE-A: TECHNICAL GUARANTEED PARTICULARS

FOR: _____

The Tenderer shall state in the following Schedule the Technical Guaranteed Particulars for the product proposed by him. Any particulars other than those specifically listed below will not be taken note of:

SL. No.	Description	Unit	Particulars

Signature: _____

Designation: _____

Date: _____



Name of Tenderer: _____

SCHEDULE-B: PLACES OF MANUFACTURE, TESTING AND INSPECTION

The Tenderer shall complete the following Schedule for Equipment he proposes to supply:

SL. No.	Description	Manufacturer	Place of Manufacture	Place of Testing and Inspection

Signature: _____

Designation: _____

Date: _____

Name of Tenderer: _____



BIDDING FORM
NON-CONFLICT OF INTEREST DECLARATION
(TO BE COMPLETED BY THE BIDDER)

Tender No.:

Tender Title:

To:

Oman Airports
Muscat
Sultanate of Oman

Subject to any other legislation of the Sultanate of Oman, which relates to the matter hereunder and which may bare any provision more stringent than what is present hereunder, We [.....*full name of the bidder*] (..... *CR number of the company*)(the “Company”), submitting a Bid in respect of the tender number and title stated above (hereinafter referred to as the “Tender”) to Oman Airports “Oman Airports” (hereinafter referred to as the “Oman Airports”), hereby declare that the partners, shareholders, employees, board members of our Company, including their wives and any relative (up to the second degree) of the above mentioned do not have a conflict of interest, either directly or indirectly, with the aforementioned Tender or bid, including but not limited to the pre-tendering phase, the tendering phase, the evaluation phase (be it financial, technical or otherwise), the negotiation of the Tender, the provision of clarification on the inquiries that arise out of the Tender at any stage, the awarding of the Tender or any other process this Tender undergoes, or where we have any such conflict of interest, we have declared in this form in the appropriate section

We further declare that we are fully aware of all the laws and regulations of the Sultanate of Oman relating to any and all matters referred to in this declaration and the points hereunder:

- That we shall not directly or indirectly promise or entice to employ any employee of the Oman Airports, procure any service or purchase any goods or contract with any party in such a manner that may amount to a conflict of interest. A conflict of interest may arise out of but not limited to economic interests, political or national affinities, family or emotional ties, or any other relevant connection or shared interest;
- That we shall inform in writing an authorised representative of Oman Airports, within three (3) Working Days, of any situation constituting a conflict of interest or could give rise to a conflict of interest;
- That we have not made, and shall not to make or provide, either directly or indirectly any offer or information of any type whatsoever in relation to the Tender, from which an advantage can be derived by any party in a manner that amounts to a conflict of interest;
- That we have not granted, sought, attempted to obtain, attempted to grant or accept and will not grant, seek, attempt to obtain, attempt to grant or accept any advantage, financial or in kind, to or from any party whatsoever, constituting a bribe, a facilitation, corruption or any other illegal practice, either directly or indirectly, as an incentive or reward in relation to the Tender, its award, execution, performance and any other stage or act required by this Tender;

We, further declare and confirm that neither we nor anyone, including any of our directors, employees, agents, joint venture members, consultants or sub-contractors, where these exist, acting on our behalf with due authority or with our knowledge or consent, or facilitated by us have engaged, or will engage, in any activities which might result as a conflict of interest such as:



- direct or indirect control and / or been controlled by or under common control with another Bidder; or
- have received any direct or indirect subsidy from another Bidder; or
- have the same legal representative as another Bidder; or
- having a relationship with another Bidder, directly or through common third parties, that puts it in a position to influence the Bid of another Bidder, or influence the decisions of Oman Airports regarding this Bidding process; or
- participates in more than one Bid in this Bidding process. Participation by a Bidder in more than one Bid will result in the disqualification of all Bids in which such Bidder is involved. However, this does not limit the inclusion of the same subcontractor in more than one Bid; or
- unless specifically agreed by Oman Airports any of its affiliates participated as a consultant in the preparation of the design or technical specifications of the Works and Services that are the subject of the present Bid; or
- any of its affiliates has been hired (or is proposed to be hired) by Oman Airports as Engineer for the Contract implementation.

We understand that Oman Airports reserves the right to verify this information and that We are aware of the consequences that we may face (criminal or otherwise) in the case where we breach this Declaration or provide false information relating to it or the Tender.

We are fully aware that this Declaration does not limit our liability in any way in regards to all matters mentioned herein and that it is our duty to ensure that we fully comply with the laws and regulations of the Sultanate of Oman as and when they come into force in relation to this Declaration.

We shall inform Oman Airports, without any delay, about any event / situation which might lead to conflict of interest with Oman Airports, and confirm that we are aware of the consequences which may derive from any false declaration in this statement.

In witness whereof this Statement is signed by the duly authorized representative of the Bidder on the day and year first written above.

Dated this day of20xx

Signature in the capacity of

Duly authorized to sign Tenders for and on behalf of M/s

Affix Bidder's Official Stamp

Declaration of Interest

Name and Source of Conflict:

Workplace:

Position and Title:

Relationship:

Circumstances of Conflict:



SECTION 7

TENDER EVALUATION PLAN



7 Tender Evaluation Plan

Tender Submissions will be evaluated as per the below three stages:

Stage One - Mandatory Evaluation (Go/No Go)

Stage Two – Technical evaluation: as 100% converted into

30 Points Total Technical Score

Stage Three - Financial Evaluation: as 100% converted into

70 Points Total Financial Score

7.1 Stage One- Mandatory Criteria

The Tenderers will first be evaluated for the following mandatory; the tenderer is required to satisfy the following criteria:

No.	Criteria	Go / No Go
1	Tenderer shall submit following along with Technical Bids: <ul style="list-style-type: none"> I. Form of Tender and its Appendixes II. Copy of all addenda and circular issued III. Conformation of site knowledge Corporate details/representative	Go / No Go
2	Financial Capability Individual Vendors are required to have all of the following minimum requirements: <ul style="list-style-type: none"> I. Positive EBITDA for the last two years (2021 – 2022) II. Minimum total revenue of USD 20 million per year for the years from (2021 – 2022) III. Minimum company net worth of USD 50 million IV. Audited financial statements for the last three (3) years V. Applicable Credit Ratings Reports VI. Submission of Funding Strategy Submission of Financial for the Project	Go / No Go
3	Possession of licenses for the regulation authorities	Go / No Go
4	Submission of Manufacturer support	Go / No Go
Result		Pass/Fail

Bids that have passed the Mandatory Criteria Evaluation will be carried forward to the Stage two – Technical evaluation



7.2 Stage two -Technical Evaluation

Technical evaluation will be reviewed and appraised in compliance with the evaluation criteria given in the Weight table below. Tenders will be assigned points according to each of the evaluation criteria. All points will be then summarized in order to obtain the final technical score.

No.	Evaluation criteria	Maximum score	Minimum score
1	Proof of successful completion by the tenderer as a developer of having successfully constructed PV Plants and its PV Facilities more than 15 MWac capacity <ul style="list-style-type: none"> 5 points for each project. Min two projects. 	20	10
2	Project Delivery Schedule (Official letter to be submitted with the offer) <ul style="list-style-type: none"> ✓ 9 Months (20 points) ✓ 10 Months (17 Points) ✓ 11 Months (13 points) • Project Program 10 Points (Gantt Chart with Detailed Milestones) 	30	19
3	In House Technical Team Capability (resume for key personnel must be submitted) <ul style="list-style-type: none"> ✓ Project Manager (7 Points) ✓ Civil Engineer (5 Points) ✓ Renewable Energy Engineer/Electrical Engineer (5 Points) • HSE Supervisor (3 Points) 	20	17
4	Bidders QA/QC & HSE Plan must be submitted. <ul style="list-style-type: none"> ✓ Quality Management/ Quality Plan Policy (5 Points). ✓ Submission of staff QA/QC Courses or Training Record (for 2 staff 2 points each) ✓ Company HSE Policy and Certificates (5 Points). • Submission of staff HSE Training Record (2 staff 2 points each) 	18	10
5	Project Method of Work Plan <ul style="list-style-type: none"> ✓ Project Method Statement: 7 points • Stamped BOQ and Tender Documents: 5 points 	12	7
Maximum/Minimum Passing Score		100	63



Bids that have passed the Technical Evaluation will be carried forward to the Stage Three – Commercial Evaluation

Stage Three Evaluation: Commercial Evaluation Criteria

SNo.	Criteria	Max
1	Quoted Monthly Lease Amount (in OMR) The lowest Quoted Monthly Lease Amount will be given 75 marks. Other bidders have marks based on the following formula: $\text{Score} = (\text{Lowest Quoted Monthly Lease Amount} / \text{Quoted Monthly Lease Amount}) * 75$	75
2	Quoted Annual Energy Forecast (in MWh) Sum for 25 years The highest Quoted Annual Energy Forecast will be given 15 points. Other bidders have marks based on the following formula: $\text{Score} = (\text{Quoted Annual Energy Forecast} / \text{Highest Quoted Annual Energy Forecast}) * 15$	15
3	Submission of Lease agreement Major clauses of lease agreement favoring OA, 10 Marks Balanced Lease agreement, 5 Marks Major clauses of lease agreement against OA, 0 Marks	10
	Maximum/Minimum Passing Score	100

7.3 Final Combined Evaluation

All the Tender Prices will be checked & verified for any errors, omissions and/or qualifications.

Then the tenders will be ranked according to the financial points to be carried forward to final combined evaluation
Final Combined Evaluation

- 1) All technical scores will be converted to 30% in order to follow 30:70 Technical: Commercial ratio;
- 2) All financial scores will be converted to 70% in order to follow 30:70 Technical: Commercial ratio;
- 3) Scores reduced as per items 1 and 2 above will then be summarized in order to obtain the final combined score;
- 4) All tenderers shall be ranked according to the final score. Tenders, collecting the highest combined score will be considered for recommendation for award.

*Important Note

Following the provisions of above, OA is not bound to accept the lowest offering. OA reserves the right to base its final judgment on a variety of service-related factors, other than the net bid value.

OA may at his direction or discretion may change or improve the Evaluation Criteria before or after the TENDER closing date.



SECTION “8” VALUE ADDEDE TAX (VAT)



8 Price and Payment

8.1 All payments made by OAMC to the Services Provider under this Agreement are exclusive of VAT. If any VAT is chargeable in respect of any payments, the Services Provider shall pay the VAT at the applicable rate. The Services Provider shall provide documentation and such other evidence as necessary for OAMC to claim any relevant credit for the Value Added Tax.

8.2 In the event that the OAMC has incurred or will incur costs and expenses, and where some or all of these costs and expenses are or will be recharged to the Services Provider separately to compensation for services, and there has been or will be VAT incurred on these costs and expenses, then the VAT on the recharges shall be treated as follows:

- A. If after employing reasonable efforts and procedural and legal compliance, OAMC does not have a right to recover this VAT from the relevant tax authority, whether through filing of a local VAT return or other scheme or mechanism, then the value of the recharges shall be calculated as inclusive of the VAT that was incurred.

In all other cases, including where OAMC does have a right to recover this VAT from the relevant Tax Authority, then the value of the recharges shall be calculated without including the VAT that was incurred.

8.3 For the avoidance of doubt, it shall at all times remain the sole responsibility of the OAMC to:

- A. Assess the VAT rate(s) and VAT liability arising out of or in connection with the Agreement,
- B. Account for or pay any VAT (and any other tax liability) relating to payments made to the OAMC under the Agreement to the relevant Tax Authority
- C. To the extent the services made by OAMC in relation to International transport of passengers is zero rated according to the Oman Law and Regulations, the Service Provider will provide the necessary document/s and/or certification/s to satisfy OAMC of the zero-rating VAT treatment.

8.4 The Service Provider shall not have any recourse to OAMC in any way whatsoever for any error or failure by OAMC in relation to the VAT, including without limit:

- A. Where OAMC is subject to a VAT ruling(s), determination, announcement or generally accepted practice in connection with the Agreement.
- B. Where OAMC has assumed that can recover input VAT and (for whatever reason) and this assumption is subsequently held to be incorrect or invalid; or
- C. Where the OAMC's treatment of VAT in respect of any claim for payment made under the Agreement is subsequently held to be incorrect or invalid.



SECTION “9” ICV PLAN



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2.0	DEFINITION	55
3.0	CONTRACTOR'S ICV OBLIGATIONS	55
4.0	RIGHTS OF COMPANY	56

9 Introduction

- 9.1.1 Oman Airports is committed to complying with Laws and Regulations related to "In Country Value" (ICV) in the Sultanate of Oman. This includes, but not limited to, the ICV and Omanization mandate for all contractors with which company conducts business. Consequently, the Contractor's compliance with the obligations of this Section is a fundamental condition of this contract. The contractor must achieve all agreed ICV commitments and plans as stated in the Contract.

10 Definition

- 10.1.1 ICV means the total spend retained in the country that can benefit business development, contribute to human capability development and stimulate productivity in the Omani economy. In short, products made Oman and services provided by Omanis.
- 10.1.2 Omanisation, goods made in Oman, Oman based services and development of Omanis personnel are the primary key elements for ICV.

11 Contractor's ICV Obligations

- 11.1.1 Contractor shall comply with Article 11 of Royal Decree 35/2003. This requires the Contractor to maximize employment opportunities for Omanis and meet certain Omanisation levels for certain professions. Contractor shall always keep a valid record of its employment data including the total number of staff, number of Omani staff, current positions, and dates of employment, remuneration details and valid pension numbers for Omani staff. Contractor shall report on a quarterly basis the aforesaid information and Contractor is required to submit all supporting documents (including Ministerial certificates or letters, copies of contracts of employment when required).
- 11.1.2 Contractor shall comply with Article 36 of Royal Decree 36/2008. This requires the Contractor to give preference to goods and products manufactured locally in Oman. In its sourcing and procurement activities, Contractor shall upon receipt of the relevant Ministry of Commerce and Industry (MOCI) Certificate, apply for a maximum of ten per cent (10%) price benefit over foreign products in making the price comparison for the sourcing decisions. Contractor shall keep a record of all procurement sourcing activities and report on a quarterly basis.
- 11.1.3 Contractor shall comply with Governmental Circular No. 5/2014. This requires the Contractor to subcontract a minimum of 10% (ten per cent) of the work when calculated as a percentage of the contract price to Small and Medium Enterprises SME(s). Priority in awarding subcontracts shall be given to SMEs that hold a valid entrepreneur card issued by the Public Authority for SME Development (Riyada). In the absence of entrepreneur card holder, Contractor shall give preference to SME(s) who have registration certificate/ letter by Riyada. Contractor shall obtain a copy of Entrepreneur card or letter issued by the Public Authority for SME Development (Riyada) for any SMEs been subcontracted in the contract with all documentation to approve his compliance. Contractor shall keep a record of all subcontract sourcing activities for SMEs and report on a quarterly basis.
- 11.1.4 Contractor shall comply with Royal Decree 9/2014 establishing the Omani Authority of Partnership for Development (OAPFD in short PFD).
- 11.1.5 Contractor shall Sign the offset contract with Omani Authority for Partnership for Development (PFD) before Signed this contract. This stipulates that in the event of Contract awards falling under any of the below categories, the Contractor shall be deemed familiar with and shall comply with the PFD Law requirements found @ <https://oapfd.om/en/Pages/Home.aspx>. The award categories are:
- 11.1.5.1 Value of the awarded Contract or the cumulative value of all Contracts awarded to the same company within 24 months exceeds OMR 5,000,000 (Omani Rials 5 million).



- 11.1.5.2 Awarded to foreign Contractors for the supply of goods and/or services with a total value in excess of five million Omani Rial (OMR 5 million)
- 11.1.5.3 Contracts awarded to local Omani Companies where the foreign content of the awarded Contract(s) exceeds OMR 5 million.

12 Rights of Company

- 12.1.1 At any time during the Contract period, the Company reserves the right to request the Contractor to provide an overall Contractor ICV performance report for review.
- 12.1.2 At any time during the Contract and for a subsequent period of two (2) years thereafter, Company shall have the right to audit or appoint a third party to audit any information regarding ICV provided by Contractor and /or request additional supporting information.
- 12.1.3 Contractor shall comply with the mandatory list (Appendix C) where its applicable for the contract and the client have the right to request for any information in term of (type of Product/Service, Manufacture/Service provider, price, Quantity) as well as have the right to audit at any time during the contract duration and if required after 3 years after contract expiry date



APPENDIXES

- Appendix A- Bill of Quantities
- Appendix B-Method of Statement
- Appendix C-Annexures Combined
- Appendix D- Annexure kmz file for MCT and SLL
- Appendix E- APSR Solar Guidance
- Appendix F-Health & safety Guidelines
- Appendix G- OIA Mandatory List
- Appendix H - CAA NOC's for Muscat and Salalah Airports



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Oman Airports



Project Information Note for Solar PV Projects at Muscat (MCT) & Salalah (SLL)

Disclaimer

- This document is being released only for information purposes to prospective bidders for the RfP being released by Oman Airports (OA) titled “Design, Engineering, Supply, Erection, Testing, Commissioning including Operation and Maintenance of 20MW (Muscat) & 6MW (Salalah) Solar PV Projects on Build Own Operate Lease Basis for 25 years”. **The details provided are only for information and not binding either on Bidder or on OA. Bidder to make independent evaluation by following provisions of the RfP.**
- Readers should also note that actual results relating to the project may change due to inherent statistical variations in performance of machines and market conditions and therefore, the actual results as estimated in the document are not guaranteed.
- The conclusions arrived at by OA constitute an opinion of OA and each party concerned ought to draw its own conclusions based on making independent enquiries and verifications. The document has been divided into several sections for ease of reading and developing a logical analysis of various issues involved. Any inference based on partial reading of the document may result in conclusions divergent from those presented in the document.
- OA assume no liability for any errors or omissions in the information contained in this report or for any actions taken in reliance on such information. Neither OA, nor Consultants shall not be responsible or liable for any direct, indirect, incidental, consequential, special, or punitive damages arising out of or in connection with the use or reliance on any information contained in this report.
- Reliance on this document does not waive Bidder’s responsibility of Site Visit and Independent verification of the data presented in this document.

An aerial photograph of Muscat International Airport (MCT) and the surrounding urban landscape. The airport's runways, taxiways, and terminal buildings are clearly visible in the center. To the right, a complex highway interchange is shown. The city of Muscat is visible in the background, with its buildings and infrastructure extending towards the coast. The Red Sea is visible on the right side of the image.

Muscat - MCT

MCT Site Visit – 4th & 5th Jan 2023



MCT Layout and Evacuation Recommended – 20MW / 24.13 MWp



Indicative Layout with 11kV Evacuation at PS03 is being recommended

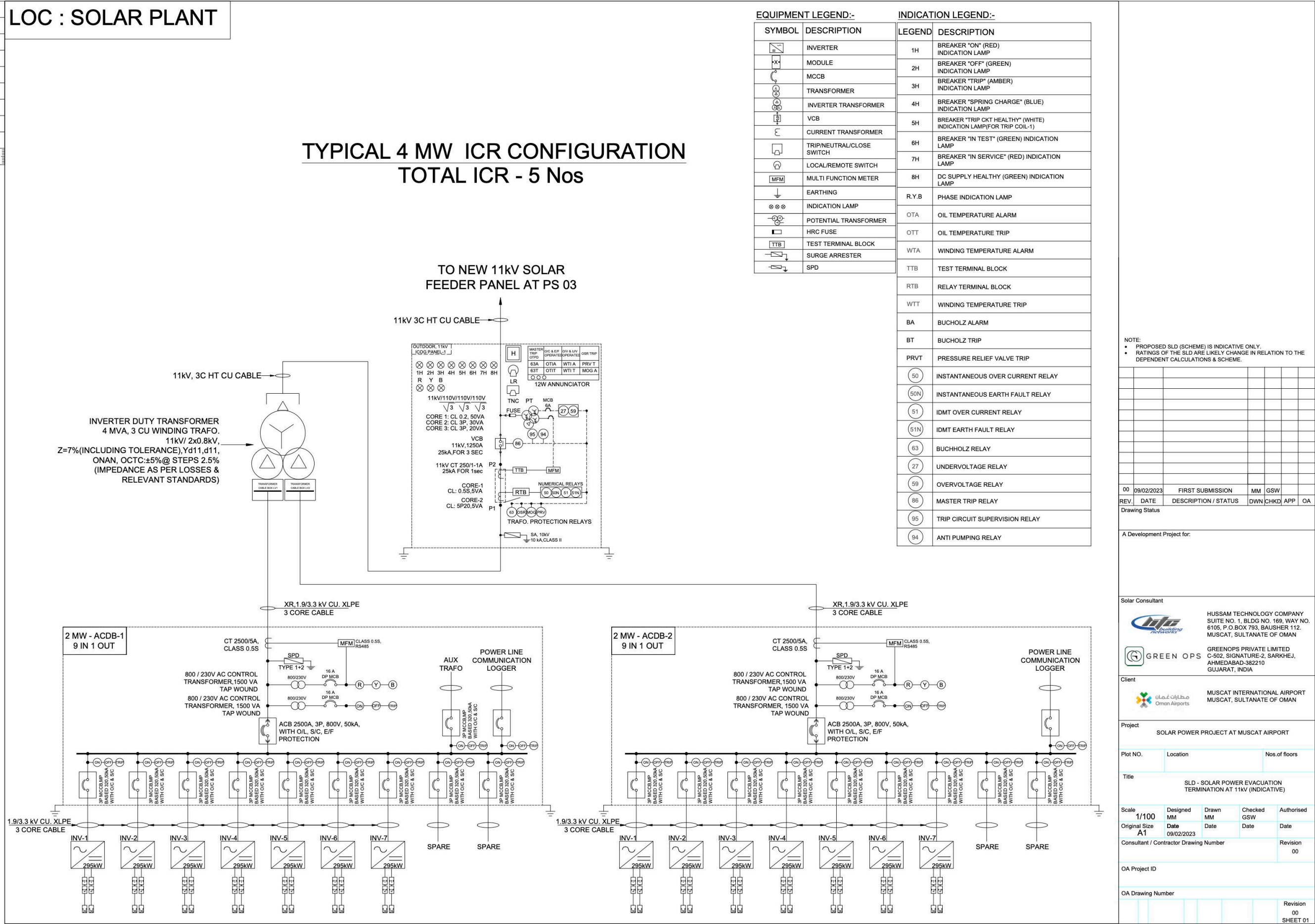
- Glare Free for Existing Runway and ATC
- Away from all major storm water discharge points, hence relatively lower land development activity and cost expected
- Close proximity to road crossing for cables going towards PS03
- Evacuation possible at PS03 at 11kV, reverse power protection at PS01.

No. of Strings	No of Tables (2P26)	DC Capacity (MWp)	AC Capacity (MW)	DC/AC (%)	Plant Area		
					In Acres	In Hectares	In Sq.Mtr
1600	800	24.13	20	1.2	69.57	28.16	281,540

MCT SLD 1/3

Typical Inverter Control Rooms of 4MW in the Solar Field with two LV Panels of 2MW each

Five Such ICRs add to 20 MWac



Zero Export (Reverse Power Protection) Setup to be installed at PS01 at 132kV level in line with guidance by OETC & APSR



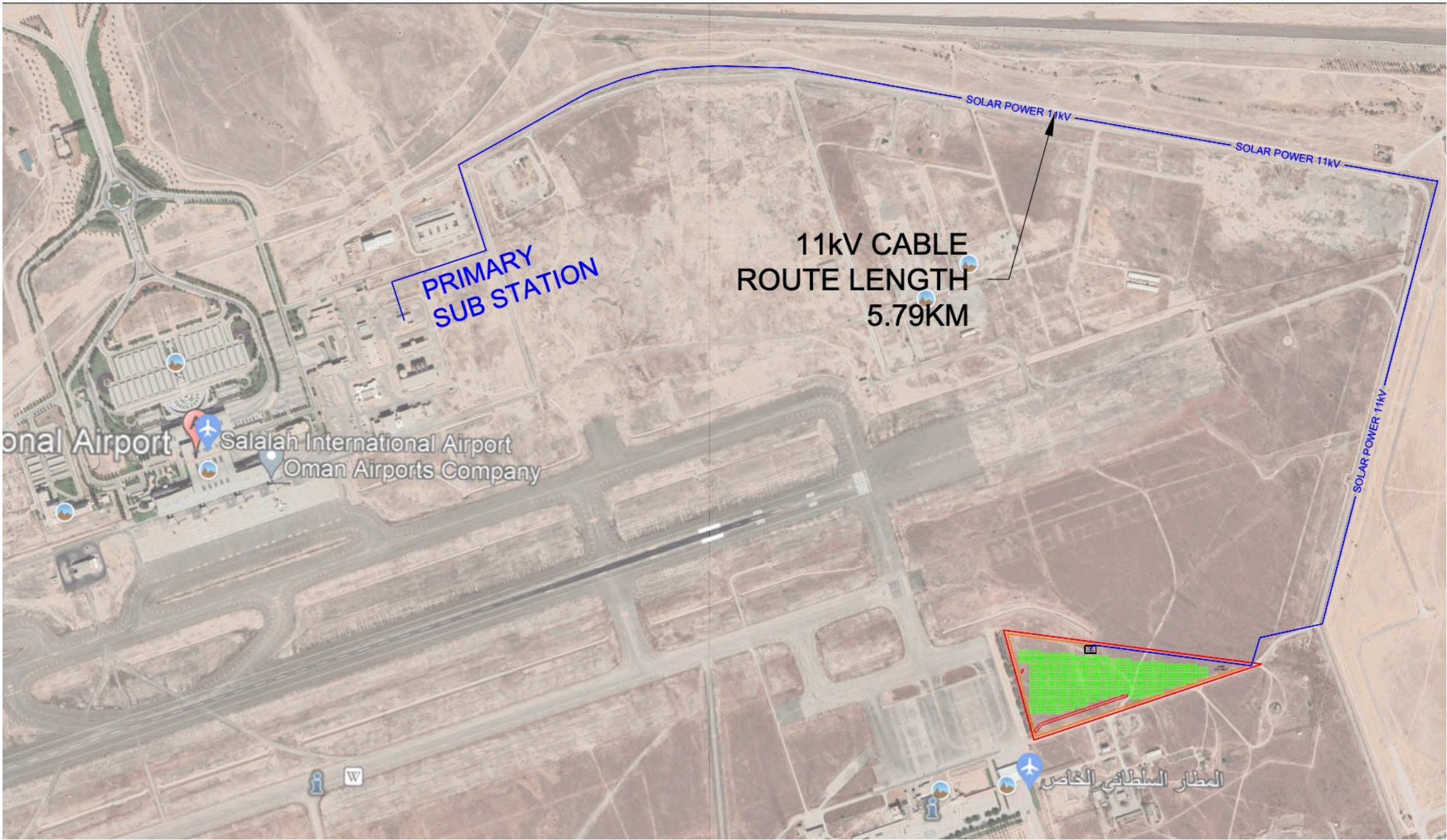
An aerial photograph of a desert landscape. A large, dark, rectangular structure, possibly a solar farm or industrial facility, is visible in the center. A winding road or path runs through the desert, and there are some small buildings or structures scattered around. The text "Salalah - SLL" is overlaid in a large, green, serif font at the bottom of the image.

Salalah - SLL

SLL Site Visit – 9th Jan 2023



SLL Layout and Evacuation Recommended – 6MW / 7.24 MWp



Indicative Layout with 11kV Evacuation

- Glare Free
- Located on slightly sloped land which is easily workable for Solar
- Reasonable distance from Primary S/S with losses within acceptable limits
- Simpler cable route following the outer periphery

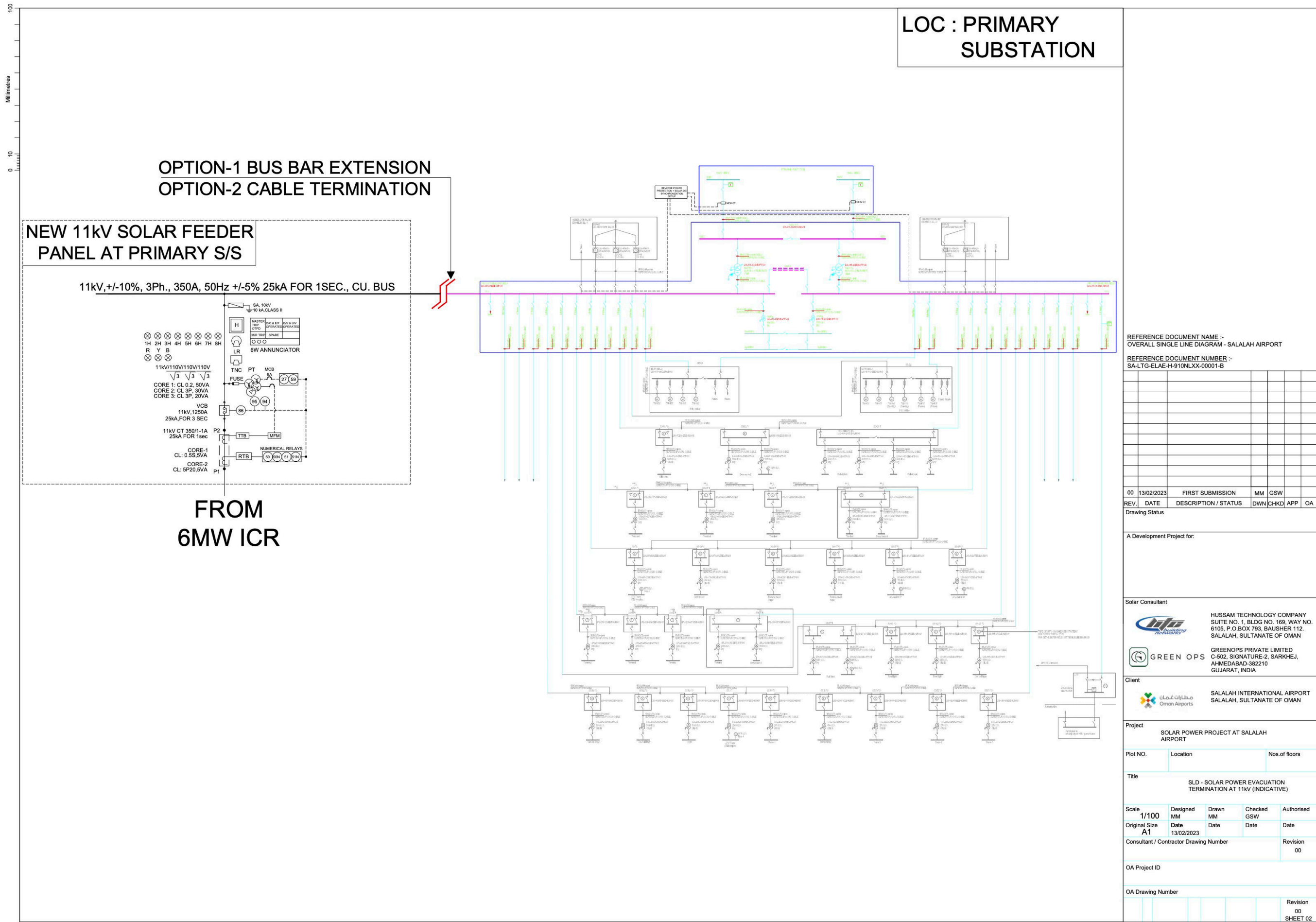
No. of Strings	No of Tables (2P26)	DC Capacity (MWp)	AC Capacity (MW)	DC/AC (%)	Plant Area		
					In Acres	In Hectares	In Sq.Mtr
480	240	7.24	6	1.2	24.68	9.99	99,876

SLL SLD 2/2

New 11kV Solar Feeder Panel (1In 1 Out) to be installed at Primary SubStation

To be connected with Existing 11kV bus via Busbar Extension or Cables

Zero Export (Reverse Power Protection) Setup to be installed at Primary SubStation at 132kV level in line with guidance by OETC & APSR





مطارات عُمان
Oman Airports



**OMAN AIRPORTS MANAGEMENT COMPANY
SULTANATE OF OMAN**

TECHNICAL SPECIFICATIONS

ITC-2308288

**DESIGN, ENGINEERING, SUPPLY, CONSTRUCTION, TESTING,
COMMISSIONING INCLUDING OPERATION AND MAINTENANCE OF 20MW
MUSCAT INTERNATIONAL AIRPORT & 6MW (SALALAH AIRPORT SOLAR PV
PROJECTS ON ASSET LEASE BASIS FOR FIXED TENURE**

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ABBREVIATIONS

A	Ampere, unit of electric current
AASHTO	American Association of State Highway and Transportation Officials
ACB	Air Circuit Breaker
ACDB	AC Distribution Box
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
APSR	Authority for Public Services Regulation
AQL	Acceptable Quality Limit
ASCE	American Society of Civil Engineers
ASCII	American Standard Code for Information Interchange
ASTM	American Society for Testing and Materials
ATC	Automated Thermal Cycler
BDV	Breakdown Voltage Test
BI	Binary Inputs
BOM	Bill of Material
CAA	Civil Aviation Authority
CB	Circuit Breaker
CBCT	Core Balance CTs
CCU	Current Converter Units
CDF	Construction Data Form
CNC	Computerized Numerical Control
CPU	Central Processing Unit
CRCA	Cold Rolled Close Annealed
CRGO	Cold Rolled Grain Oriented
CT	Current Transformer
CU	Copper
CVCC	Compound Vortex Controlled Combustion
DB	Distribution Box
DC	Direct Current
DCDB	DC Distribution Box
DCP	Dry Chemical Powder
DCRP	DISTRIBUTION CODE REVIEW PANEL
DG	Diesel Generator
DISC	Dhofar Integrated Services Company
DWC	Double Wall Corrugated
EBXL	Electron Beam Cross linked
EHV	Extra High Voltage
EMC	Electromagnetic Compatibility



EPC	Engineering, Procurement & Construction
EPDM	Ethylene Propylene Diene Monomer
ERT	Earth Resistivity Test
ESE	Early Streamer Emission
EYA	Energy Yield Assessment
FPI	Final Product Inspection
FQP	Field Quality Plan
FRLS	Flame Retardant Low Smoke
FRLSH	Flame Retardant, Low Smoke and Low Halogen
GA	General Arrangement
GB	Gigabyte
GHI	Global Horizontal Irradiance
GPRS	General Packet Radio Services
GPS	Global Positioning System
GSM	Global System for Mobile communication
GTP	GUARANTEED TECHNICAL PARTICULARS
HDD	Hard Disk Drive
HDG	Hot-Dip Galvanizing
HDPE	High Density Polyethylene
HMIS	Human Machine Interface System
HRC Fuse	High Rupturing Capacity Fuse
HSE	Health Safety & Environment
HSRS	Historical Storage And Retrieval System
HV	High Voltage
HVRT	High Voltage Ride Through
IAC	Internal Arc Classification
ICR	Inverter Control; Room
IDMT	Inverse Definite Minimum Time
IDT	Inverter Duty Transformer
IEC	International Electrotechnical Commission
IFC	International Finance Corporation
IGBT	Insulated-gate bipolar transistor
IP	Internet Protocol/ Ingress Protection
ISC	Short Circuit Current
ISO	International Organization for Standardization
KPI	Key Performance Indicators
KV	Kilo Volt
KV	kilovolt, a unit of potential difference equal to 1000 volts.
KVA	Kilo Volt Ampere
KVAR	Kilo-Volt-Amperes Reactive power
KW	Kilo Watt
LA	Lightning Arrester
LAN	local area network



LBS	Load Break Switch
LCD	Liquid Crystal Display
LDB	Lighting Distribution Board
LED	light-emitting diode
LSC	Loss of Service Continuity
LSI	Long-time + Short-time + Instantaneous
LSIG	Long-time + Short-time + Instantaneous + Equipment Ground-fault Protection
LT	Low Tension Panels
LV	Low Voltage
LVD	Low Voltage Disconnect
LVRT	Low Voltage Ride Through
MC4	Multi-Contact
MCB	Miniature Circuit Breaker
MCCB	Moulded Case Circuit Breaker
MCR	Main Control Room
MCT	Muscat
MDF	Medium-density fibreboard
MEDC	Muscat Electricity Distribution Company
MFM	Multifunctional Modules
MMS	Module Mounting Structure
MOG	Magnetic Oil Gauge
MOLG	Magnetic Oil Level Gauge
MP	Mega Pixel
MQP	Manufacturing Quality Plan
MS	Micro Soft
MV	Mega Volt
MVA	Mega Volt Ampere
MW	Megawatt, a unit of power equal to one million watts
MW AC	Sum of rated capacity of inverters in Megawatt
MW DC / MWp	Sum of installed capacity of Solar Modules in Megawatt
NCT	Neutral Current Transformer
NEMA	National Electrical Manufacturers Association
NFC	Near Field Communication
NFPA	National Fire Protection Association
NGL	Natural Ground Level
NIFPS	Nitrogen Injection Fire Protection System
NP3	Non-Pressure RCC Hume pipes
NVR	Network Video Recorder
OA	Oman Airport
OAMC	Oman Airport Management Company
OCTC	On-Circuit Tap Changer
OEM	Original Equipment Manufacturer



OES	Oman Electrical Standards
OETC	Oman Electricity Transmission Company
OHSAS	Occupational Health And Safety Assessment Series
OMAC	Organization For Machine Automation And Control
ONAN	Oil Natural Air Natural
OPC	Open Platform Communications
OTI	Oil Temperature Indicator
OWS	Operator Workstation
PB	Push Button
PCB	Printed Circuits Boards
PCC	Plain Cement Concrete
PCU	Power Conditioning Unit
PDI	Pre-Dispatch Testing
PEB	Pre Engineered Buildings
PERC	Passivated Emitter And Rear Cell
PFC	Power Factor Correction
PI	Plant Information
PID	Potential-Induced Degradation
PLC	Programmable Logic Controller
PMAX	Maximum Power
POE	Power Over Ethernet
PPC	Power Plant Controller
PPE	Polyphenylene Ether
PR	Plant Performance
PRD	Pressure Relief Device
PRV	Pressure Relief Valve
PSI	Pre-Shipment Inspection
PT	Potential Transformer
PTFE	Polytetrafluoroethylene
PTZ	Pan-Tilt-Zoom
PV	Photovoltaic
PV	Photovoltaic
PVC	Polyvinyl Chloride
PWM	Pulse Width Modulation
QAP	Quality Assurance Plans
QAT	Quality Acceptance Test
RAID	Redundant Array Of Independent Disks
RAM	Random-Access Memory
RCC	Reinforced Cement Concrete
RCCB	Residual Current Circuit Breaker
RfP	Request For Proposal
RH	Relative Humidity
RMS	Root Mean Square



RMU	Remote Monitoring Unit
RTD	Resistance Temperature Detector
RTU	Remote Terminal Unit
SA	Surge Arrester
SCADA	Supervisory Control And Data Acquisition
SCR	Silicon-Controlled Rectifier
SFRA	Storefront Reference Architecture
SLD	Single Line Diagram
SLL	Salalah
SMB	String Monitoring Box
SMS	Short Message Service
SMU	String Monitoring Unit
SOE	Sequence Of Event
SOP	Standard Operating Procedure
SPD	Surge Protection Device
SPV	Solar Photovoltaic
SS	Stainless Steel
STAAD	Structural Analysis And Design
STC	Standard Test Conditions
TB	Terabyte
TCP	Transmission Control Protocol
TCPIP	Transmission Control Protocol Internet Protocol
TFT	Thin Film Transistor
THD	Total Harmonic Distortion
TID	Temperature-Induced Degradation
TS	Technical Specification
TTB	Terminal Test Box
UBC	Uniform Building Code
UPS	Uninterrupted Power Supply
UPSDB	Uninterrupted Power Supply Distribution Box
USB	Universal Serial Bus
UV	Ultra Violet
V	Volt
VA	Volt Ampere
VAC	Ac Voltage
VCB	Vacuum Circuit Breaker
VCD	Vibrational Circular Dichroism
VDC	DC Voltage
VMP	Maximum Power Voltage
VOC	Open-Circuit Voltage
VRLA	Valve Regulated Lead Acid Battery
WMS	Weather Monitoring System
WTI	Winding Temperature Indicator



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Oman Airports



XLPE
ZVRT

Cross Linked Polyethylene
Zero-Voltage Ride Through

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Electrical System & Equipment

Solar PV Module:

This specification covers the minimum technical requirements in respect of design, engineering, manufacturing, inspection, testing, supply, transportation at site, transit insurance of PV modules and performance of Mono PERC mono facial crystalline Silicon Photovoltaic Solar modules of minimum power rating of 580 Wp at STC.

Applicable Standards & Codes

Table below presents a non-exhaustive list of standards to which the Solar Modules should confirm.

Standard	Description
IEC 61215-1:2016	Terrestrial photovoltaic (PV) modules - Design qualification and type approval - Part 1: Test requirements
IEC 61215-2:2016	Terrestrial photovoltaic (PV) modules - Design qualification and type approval - Part 2: Test procedures
IEC 61730-1:2016	Photovoltaic (PV) module safety qualification - Part 1: Requirements for construction
IEC 61730-2:2016 RLV	Photovoltaic (PV) module safety qualification - Part 2: Requirements for testing
IEC 61701:2011	Salt mist corrosion testing of photovoltaic (PV) modules
IEC 62716:2013	Photovoltaic (PV) modules - Ammonia corrosion testing
IEC TS 62804-1:2015	Photovoltaic (PV) modules - Test methods for the detection of potential-induced degradation - Part 1: Crystalline silicon
IEC 60904:2020	All Parts - Photovoltaic devices (Applicable Parts to be followed)
IEC 61853-Part-1,2,3 & 4	Photovoltaic devices – Performance testing & Energy Rating
IEC TS 62782:2016	Photovoltaic (PV) modules - Cyclic (dynamic) mechanical load testing
IEC 60068-2-68	Environmental testing - Part 2-68: Tests - Test L: Dust and sand
IEC 62759-1:2015	Photovoltaic (PV) modules - Transportation testing - Part 1: Transportation and shipping of module package units
UL 790	Fire Classification rating
EN 50380 & UL 4730	Datasheet & Name Plate information for Photovoltaic modules
TUV /UL/VDE /Intertek	Comply with the essential requirements applicable to PV module IEC certifications
DNVGL/PVEK/RETC/STS/SGS/CFV/PI/ISE/BV	Module related technical/ quality validations and testing
ISO:9001-2015	Quality, Health & Safety certification for factory
ISO:14001-2015	ISO: 9001-2015 - Design, Manufacture & supply of solar cell, Solar modules
OHSAS 18001-2007 recertification	ISO: 14001-2015 - Design, Manufacture & supply of solar cell, Solar modules
ISO/IEC 17025:2017	General requirements for the competence of testing and calibration laboratories
“Triple IEC Standard” Certification / ultimate reliability test	To evaluate the performance of PV modules to see if they are reliable and safe in the long-term.
IEC 62790	Junction boxes for photovoltaic modules – Safety requirements and tests



IEC TS 62941	Terrestrial photovoltaic (PV) modules - Guideline for increased confidence in PV module design qualification and type approval
--------------	--

Notes:

- PV Module shall be compliant to most recent standards (and latest amendments if any) developed by IEC and other applicable standards.
- The Manufacturer shall submit IEC certificates & type test report for above mentioned applicable standards and codes.

General Requirements:

- PV modules shall be the same make, model and power class across the Sites and interchangeable.
- Module manufacturer shall submit third party verified .PAN files for module Wp finalized and these should match with the parameters in the Datasheet submitted for the project. Mismatch between the data in PAN files & Datasheet shall not be allowed.
- Module manufacturer shall provide their corresponding pallet wise flash test measurement data for the supplied modules along-with packing list which shall comply with the current sorting bins indicated by the manufacturer.
- All PV modules to be installed in this PV Power Plant are recommended to be manufactured in the same factory. In case of manufacturing to take place in more than one factory, Manufacturer shall provide all manufacturing documentation requested by the client from all PV module manufacturing facilities. No OEM-based manufacturing is allowed.
- The measurements shall be carried out with AAA-class sun simulator. Measuring uncertainty of module power within the factory including testing equipment tolerances/calibrated modules shall not be more than $\pm 2\%$.
- The Supplier shall provide a valid calibration certificate of the apparatus used.
- All modules selected for sampling inspection will be re-tested in the sun-simulator.
- Module manufacturer shall submit BOM for the supply of modules and the BOM shall be as per Construction Data Form (CDF) duly certified by third party independent lab and same as provided during third-party accelerated laboratory tests. Deviation in BOM submitted shall not be allowed once approved.
- However, any change in BOM, which has the impact of affecting project timelines, shall have to be informed to the client & approved therein.
- The module manufacturer shall confirm to negative grounding requirements of modules.
- The module shall be suitable to mount in portrait or landscape manner. Module manufacturer to give mounting details for the same with suitable cable lengths as per portrait or landscape configuration.
- The PV modules of the same nominal power shall be classified into no less than three levels based on its current in factory and delivered to site in such classification for installation, to minimize mismatch loss.
- The module shall not be subjected to any point load during transportation and complete care must be taken to avoid any undue loading on either side of the module.
- The module manufacturer shall provide the solar PV module electrical characteristics including current-voltage (I-V) performance curves and temperature coefficients of power, voltage and current.
- The Client may send qualified staff to conduct at-factory surveillance or appoint an accredited international organization. The surveillance procedure shall be mutually reviewed and approved by the client.



- The PV manufacturer should conduct in-line EL imaging test (to check invisible/micro crack) and appearance inspection on all PV modules in the production stage according to a testing and inspection standards.
- Module manufacturer shall submit EL images of all the supplied modules for the project in suitable electronic format.
- Each PV module deployed must use a Radio Frequency identification (RFID) tag for traceability. RFID tag must be able to withstand harsh environmental conditions during the module lifetime.

Design Requirements:

- Module shall have only +ve tolerance i.e., 0 to +5Wp of the module capacity.
- The selected module shall be of minimum nameplate rating at 580 Wp.
- All the modules supplied shall have 100% compliance to cell design considering MBB. Supply of mixed quantity of modules with different designs shall not be accepted.
- The PV modules shall be able to operate under extreme ambient temperature (-40°C to +85°C) and humidity (5% to 95%) conditions and will be designed to ensure the highest possible reliability in operation and to ensure minimum and efficient required maintenance over the lifetime of the system.
- Module shall be EVA and POE (Poly olefin Elastomer) encapsulated.
- The interconnected cells shall be laminated in vacuum to withstand adverse environmental conditions. The EVA used for the modules should be of UV resistant in nature.
- The back sheet shall have globally benchmarked durability properties on Moisture barrier, Tensile Strength, Elongation retention and UV stability and shall be able to withstand system voltage.
- The frame of module shall be of aluminum / aluminum alloy. The frame structure should be free of projections which could result in lodgment of water, dust, or other matter. The anodized Aluminium alloy frame thickness should be minimum 35mm.
- The front glass used to make the crystalline silicon modules shall be toughened low iron glass with minimum thickness of 3.2 mm.
- Front glass shall have maximum wind loading capacity of 2400 Pa and maximum snow loading capacity of 5400 Pa.
- Junction Box shall have an Ingress protection rating of at least IP68 with bypass diodes as per PV module design. The by-pass diode shall have passed the thermal test as per IEC-61215.
- Each PV module shall be bundled with positive/negative outgoing cables with minimum length required for supporting leapfrog technique for Portrait configuration and terminated with DC plug-in connector (MC4 type) directly. The bundled cables for series connection shall be flame-retardant cables that can withstand ultraviolet radiation, aging, high temperature, corrosion, and insulated, flame-retardant copper-core cables meeting the performance requirements. The bundled cables shall comply with service life expectancy of 25 years.
- The positive (+) terminal has a male connector while the negative (-) terminal has a female connector.
- Module shall have class 'C' (IEC61730)/ Type1 (UL1703) fire rating, safety Class II as per relevant IEC standards.
- It is required that solar cells used in one PV module are of the same batch, uniform in color, and free of mechanical damages and oxidation spots at welds. Also, solar cells



shall have uniform I-V characteristic curve.

- Module shall have both mounting arrangement with holes and clamps. Specific module mounting arrangement shall be finalized during detailed engineering.
- Modules shall be PID free. Certificates should be provided by independent, internationally renowned, and accredited testing laboratories stating that the modules are PID free.
- The module manufacturer shall share its approval for suitable or applicable module cleaning systems as per site conditions.
- Module must be compatible with fully/semiautomatic robotic cleaning system without any violation of warranty. Module manufacturer must recommend at-least two robotic cleaning suppliers which help meet the above criteria.
- Module Name plate requirements: All individual modules shall be provided with Name Plate label at the backside of module which shall provide at least below information for identification. They shall be clearly visible and shall not be hidden by equipment wiring. Type of labels and fixing of labels shall be such that they are not likely to peel off/fall off during the life of the panel.
 1. Manufacturer's Name
 2. Model Number, Serial Number
 3. Maximum Power (P_{MAX}), Voltage (V_{MP}), Current (I_{MP})
 4. Short Circuit Current (I_{SC}), Open Circuit Voltage (V_{OC})
 5. Main System Voltage
 6. Relevant standards, Certification lab. name
 7. Warnings, if any

Packing

- PV Module manufacturer shall send its packing details for client's approval.
- Packing shall be sea/road worthy depending on the mode of the transportation.
- All pallets and individual modules shall be bearing weatherproof Current Bin Classification i.e. properly identified as per Impv range/average value or color code to avoid intermixing/mismatch losses during installation at site.
- Module manufacturer shall ensure that the pallets are completely waterproof so that the packing is not affected in case of rainy conditions at site during installation and thus avoid damage to modules. Module manufacturer shall submit packing details in proof of this requirement. The packaging methodology shall be suitable according to IEC 62759-1 and industry best practice.

Limited Product And Peak Power Warranty

• Limited Product Warranty

Supplier / Manufacturer assures that under the conditions for regular application, installation, use and service, the integral module (including attached DC connectors, cables) can meet the demand of regular application, use and installation and have no defect caused by material and process within 12 years as of the Warranty Effective Date. If the modules get out of order or fail to operate due to design deficiency, material & manufacturing process defects within 12 years as of the Warranty Effective Date, Supplier provides remedy, only repairing and replacing the failed modules of the same wattage capacity (includes same model and technology) after verification and confirmation by an independent testing institution agreed by Supplier and the client in advance. It also covers the workmanship that provides for all shipping costs and parts and labour required to replace or repair warranty-eligible failures.

• Concealment Warranty



Supplier/Manufacturer to ensure that the terms and conditions of the shipping insurance include concealment clause for up to 60 days. In the event of delay in opening containers, cases or other packages at the project premises, loss of or damage to the asset insured discovered on opening shall be deemed to have occurred during the currency of shipping policy and shall be recoverable. Any container and/or case and/or package showing signs of damage will be opened immediately on arrival at final destination and informed to the shipper.

- **Serial Defect Warranty**

Module manufacturer shall include Serial Defect Warranty which shall be valid in case of 2% of solar modules show similar defects.

The manufacturer guarantees that if 2% of modules, within a particular production run or timeframe are found to have a specific defect, the manufacturer will replace or repair those modules at no cost to the customer.

Module Manufacturer shall also provide remedy steps taken for the Serial Defect Warranty occurring due to any of the reason Design, Manufacturing or Material.

- **Limited Peak Power Warranty**

- a) Actual O/P Power end of the first year: will exhibit a power output no less than 98% of the name plate's peak power output specified on the product under Standard Testing Conditions of 25°C, 1.5 AM, 1000 W/m2.
 - b) Actual O/P power for subsequent 2nd to 30th years: will decline annually by no more than 0.5% of the name plate's peak power output specified on the product under the Standard Testing Conditions of 25°C, 1.5 AM, 1000 W/m2.
- Preference shall be given to the 30 year warranty period.
 - If Module(s) fail(s) to exhibit such power output in prescribed time span, the manufacturer / supplier shall either deliver additional PV Module(s) to replace the missing power output with no change in area of land used or replace the PV Module(s) with same power (Wp) (+ve tolerance 0 to +5Wp) with no change in area of land used at client's sole option.
 - The Supplier / Manufacturer shall submit Limited Warranty Statement of PV Module(s) for client's approval.
 - All warrantees shall be backed with third party insurance.

Quality Assurance

Module manufacturer shall submit standard MQP/QAP for approval from the client. Any deviations, if raised shall be mutually agreed and justified. Broadly, it shall include at least the following inspection points:

- 100% production supervision (sample based on 100% inline during production) can be done by client or or it's third party agency representative to ensure that the vendor uses the correct components and that the manufacturing processes implemented can guarantee the conditions to obtain the required level of quality for the products. It includes Material control auditing; Production processes auditing and production monitoring at the vendor's module product facility; The supervision starts with the reception of the components intended to be used for the production lot until completion of the packing and shipment of the products from the factory.
- Modules to be supplied can be subjected to pre-shipment and post shipment (at port) inspection by Third Party Shipment Inspection as per sampling plan mutually agreed between concerned parties. During pre-shipment inspection, the quantity of products to be sampled and inspected shall be determined using ISO 2859 guidelines. Samples shall be selected by third party inspectors from the entire lot through AQL. An



acceptance criterion for solar modules shall be defined where key parameters will include at least Electrical IV test, visual inspection and electroluminescence (EL) test.

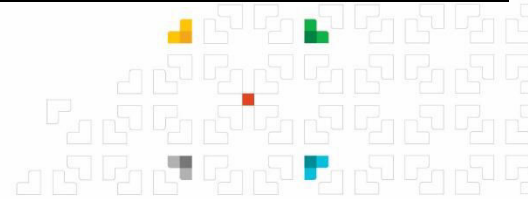
- Sample of modules from each lot shall also be subjected to electrical IV flash test and EL testing at external laboratory by third party inspection agency.
- Container loading check shall be performed to confirm that containers are loaded with the correct solar modules and that serial numbers of the modules loaded correspond with packing list and related documents, such documents shall be provided by the vendor prior to the container loading. The loading into the container is also verified in terms of loading method and usage of correct packaging materials. The placing of the container seal is observed and verified.
- Specific requirements related to testing or submission of documentation. If any shall be reviewed and agreed.

Manufacturing & Inspection

- The Manufacturer / Contractor shall inform the module manufacturing schedule to the client at least 15 working days before the start of proposed schedule.
- Inspection must be done by contractor or 3rd party consultant in line with their inspection list, Inspection & Tests are not limited to this particular documents, might be added at time of project development. Such 3rd Party consultant can be involved while approving MQP/QAP of the vendor during project award stage.
- The client shall perform material inspection at the Manufacturer's factory before the start of proposed manufacturing schedule. Proof of procurement of components as per the approved BOM mentioning manufacturer name, manufacturing date and relevant test certificate shall be submitted during material inspection for verification.
- The Manufacturing shall start only after the clearance by the client after the material inspection.
- The cells used for module making shall be free from all defects like edge chipping, breakages, printing defects, discoloration of top surface etc. Only Class A solar cell shall be used.
- The modules shall be uniformly laminated without any lamination defects.
- Cells, Connectors, EVA Backsheet ,cables etc raw materials samplings test at factory to be done before Module Manufacturing process.
- Different color codes or identification codes shall be provided on the modules as well as pallet for identification of different bins sorting.
- Client can inspect the module on receipt at port/site by sampling and sending them to third party lab.
- Following mandatory pre-dispatch inspection of modules shall be performed. Additional tests can be done as per the mutually approved Pre-dispatch testing document.

Sample Size As Per ISO 2859-1: 1999

Sr. No.	FAT / PDI Test Name
1	Flash Testing
2	Visual Inspection test
3	EL testing
4	Ground continuity test
5	RFID Verification



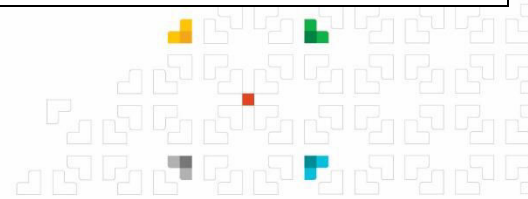


Note: The test listed above are indicative only and subjected to the client's approval and other tests which are not mentioned above but required for satisfactory operation of the PV Module are deemed to be included in the Pre-Dispatch Inspection list without extra charges.

Submission

The following list of documents to be submitted by the solar module manufactures/ vendor at different stages of procurement as mentioned below:

Stage	Document Name
Engg.	PV Module's standard Vendor Datasheet (signed & stamped copy)
Engg.	G.A. Drawing of PV Module
Engg.	PAN File (with Third party verification Report)
Dispatch	Current BIN sorting details & chart
Engg.	Manufacturing Quality Plan (MQP)
Engg.	Quality Assurance Plan (QAP) and Pre-Shipment Inspection (PSI)
Engg.	PV Module Visual Inspection Criteria
Engg.	PV Module Level EL Criteria
Dispatch	Electro- Luminescence (EL) Test reports
Engg.	Detailed BOM of PV Module (as per the type tested and approved Constructional Data Form (CDF))
Engg.	CDF (Constructional Data Form) document of Product Certification Agency
Engg.	Other Certificates (UL / ISO etc.)
Engg.	LeTID test report
Engg.	Standard Warranty (Limited Warranty)
Engg.	Power O/P schedule of module (Degradation chart) for each year till 25th year (Signed & Stamped copy on Letter head of company)
Dispatch	Insurance backed warranty
Engg.	Installation Manual
Dispatch	Flash data (Documents from supplier to Customer Before Shipment - 100 % to be provided)
Dispatch	Dual Stage 100% Module E.L. images Inspection post simulator (Documents from supplier to Customer Before Shipment - 100 % to be provided)
Dispatch	Final Product Inspection (FPI) summary (Documents from supplier to Customer Before Shipment - 100 % to be provided)
Dispatch	SOP i) Instruction for Module Unpacking ii) Instruction for Module Packing iii) Container Unloading precaution
Engg.	Detailed write up on PV Module Earthing
Engg.	I-V curve of offered module (not typical)
Engg.	Module cleaning guidelines as per site conditions for front and rear side





Dispatch	Waste disposal process at the end of PV module life along with agency name and details
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Notes:

The drawings & documents listed above are indicative only. The drawings & documents which are not mentioned above but required for approval of the equipment from client are deemed to be included.

Schedule Of Deviation

The bidder hereby certifies that the above mentioned are the only deviations from the client's Technical Specifications for this enquiry. The bidder further confirms that in the event any other data and information presented in his proposal and accompanying documents including drawings, catalogues, etc., are at variance with the requirements laid out in the client's Technical Specifications, then the later shall govern and shall be binding on the bidder for the quoted price.

Solar Inverter/ Power Conditioning Unit (PCU)

This specification covers the minimum technical requirements in respect of manufacturing, inspection, testing, supply, transportation at site, transit insurance, commissioning and performance testing of Solar Inverters / PCU of minimum capacity of 200 kW @ 50 Degree for String Inverter/PCU.

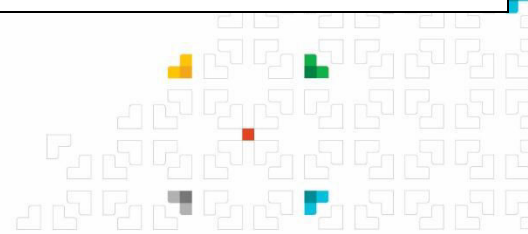
The continuous combined capacity of all Solar Inverters /P.C.U. shall not be less than quoted project capacity at unity power factor at ambient temperature of 50 degree Celsius.

The Solar Inverter must be compatible with Zero Export infrastructure and must be able to ramp up/down the generation in sync with Power Plant Controller. Inverter OEM to recommended compatible PPC/SCADA systems to achieve the said functionality.

Applicable Standards & Codes:

Table below presents a non-exhaustive list of standards to which the Solar String Inverter should confirm.

Standard	Description
IEC 61000 (All Applicable Parts)	Electromagnetic compatibility (EMC)
IEC TS 63157:2019	Photovoltaic systems - Guidelines for effective quality assurance of power conversion equipment
IEC 62109	(all applicable parts): Safety of power converters for use in photovoltaic power systems
IEC TS 62910: 2020	Utility Interconnected PV Inverters – Test Procedure for under voltage Ride – through measurements
IEC 61727: 2004	Photovoltaic (PV) systems – Characteristics of the utility interface
IEC 61683: 1999	Photovoltaic systems - Power conditioners - Procedure for measuring efficiency
EN 50530	Overall efficiency of grid connected photovoltaic inverters
IEC 62116: 2014	Utility-interconnected photovoltaic inverters - Test procedure of islanding prevention measures
IEC62477-1: 2012 +AMD1 :2016	Safety requirements for power electronic converter systems and equipment - Part 1: General





IEC 62093: 2005	Balance-of-system components for photovoltaic systems -Design qualification natural environments
IEC 62920: 2017+AMD1: 2021 PRV	Photovoltaic power generating systems - EMC requirements and test methods for power conversion equipment
IEC 60068-2-2020 SER Series	Environmental Testing – Part 2: Test – All Applicable Parts
IEC 60529:1989 +AMD1: 1999 +AMD2:2013	Degrees of protection provided by enclosures (IP Code)
IEC/EN 60068-2-68	Sand & Dust testing on the Proposed Solar inverters
	Local Grid Codes / Guidelines Compliance (with latest amendment)
	Local Electricity Codes compliance (with latest amendment)
	Latest published requirements by APSR, OETC and Applicable Distribution Company must be complied with.
EN 50524	Data sheet and name plate for photovoltaic inverters

Notes:

- The Solar Inverters / P.C.U. shall be compliant to most recent standards (and latest amendments) for above mentioned International Codes and standards and other applicable standards along with the APSR guidelines, safety codes and standards.
- The Manufacturer / supplier shall submit type test certificates and type test reports for above-mentioned standards and codes.

General Requirements:

- The offered equipment shall be new with state of art technology and proven field track record. No prototype equipment shall be offered.
- The offered String Inverter's .OND file should to be third party verified.
- The supplier/Manufacturer shall ensure availability of all required spare parts and maintenance support services for the offered equipment in Oman.
- PCU will be suitable to 1500 Vdc system voltage.
- PCU shall be DC overload maximum upto 20% only.
- The Manufacture/supplier needs to submit all the relevant technical documents/test report in support of declared PCU design DC overloading capacity.
- The solar inverters shall remain connected to the grid as per Local Grid Codes with all latest amendments and its components shall be designed accordingly.
- In case auxiliary supply of PCU is met internally, then it should have sufficient power backup to meet the LVRT requirement. Manufacturer needs to submit the detail auxiliary supply arrangement for PCU during detail engineering stage.
- The power factor value shall be adjustable from 0.9 lag to 0.9 lead and work continuously in unity if it is necessary. Also, the PCU shall permit to change the and regulate the power factor, reactive/active power, start, stop, ratio ramp up and ramp down from the control system of the plant.
- All PCUs should be able to inject reactive power as per local grid requirement.
- Password protection shall be provided to provide security against unauthorized parameter access.
- In case of grid failure, the PCU shall be re-synchronized with grid after revival of power supply. Manufacturer to furnish the time taken by PCU to be resynchronized after restoration of grid supply during detailed engineering.



- PCU shall have active power limit control, reactive power and power factor control feature. Plant operator shall be able to provide (manual intervention) Active power, reactive power and power factor control/limit set point through SCADA HMI and local control display unit (or Laptop computer). PCU shall be provided with remote start and stop facility from SCADA HMI. It shall also be able to operate in sync with leading Power Plant Controllers (PPC) as real time reverse power control mechanisms will be implemented.
- Minimum acceptable overall efficiency shall be as per EN 50530 and preference may be given to inverters having higher efficiency than desired.
- The manufacturer shall specify the conversion efficiency at following load conditions i.e. 25%, 50%, 75% and 100%, which shall be confirmed by type test reports.
- The efficiency of the Inverter should be greater than 95 % with a general guarantee of at least 10 years. Efficiency degradation curve to be provided by OEM.
- Overall Efficiency of the inverter shall include the inverter and all its auxiliaries (such as the cooling system), Output Sinus Filter, Power Factor Correction and Harmonic Filter (if any of the is applicable).
- Curve of efficiency is required for partial loads from 50% to 100% & for the temperature ranges of the project.
- The PCU must be self-managing and stable in operation.
- PCU shall have thermal overloading protection to prevent failure of switching devices (i.e. IGBT) and other components of Inverter. PCU controller shall automatically regulate/limit the power output in order to reduce the PCU cabinet and switching devices temperature. Manufacturer to submit the PCU power vs ambient temperature curve. PCU shall be able to provide cabinet and IGBT's (switching device) temperature to SCADA system for remote monitoring, storing and report generation purpose.
- PCU shall have the following feature,
 - i. AC & DC overcurrent protection.
 - ii. Synchronization loss protection.
 - iii. Over temperature protection.
 - iv. DC & AC under and over voltage protection.
 - v. Under & over frequency protection.
 - vi. Cooling system failure protection
 - vii. PV array ground fault monitoring & detection
 - viii. PV array insulation monitoring
 - ix. LVRT /HVRT /ZVRT as applicable for country's local grid code
 - x. Anti-islanding protection
 - xi. Grid monitoring
 - xii. Individual PV Module String current monitoring
 - xiii. Any other specific requirement as per local grid of the region
- The monitoring/measurement of DC inputs and AC output shall be done using transducers/instruments having sensor accuracy of 0.5 class or better.
- Internal Surge Protection Device (SPD) shall be provided in the PCU on DC and AC side. Data pertaining to the discharge capability of the SPD shall be submitted.
- Ground fault detector which is essential for large scale PV Plants in view of appreciable discharge current with respect to ground.
- PCU shall have necessary limiters in build in the controller so as to ensure safe operation of the PCU within the designed operational parameters.



- The PCU shall include appropriate self-protective and self-diagnostic feature to protect itself and the PV array from damage in the event of PCU component failure or from parameters beyond the PCU's safe operating range due to internal or external causes. The self-protective features shall not allow signals from the PCU front panel to cause the PCU to be operated in a manner which may be unsafe or damaging. Faults due to malfunctioning within the PCU, including commutation failure, shall be cleared by the PCU protective devices. In addition, it shall have following minimum protection against various possible faults.
 - i. Earth Leakage Faults: The PCU shall have the required protection arrangements against earth leakage faults and –ve DC directional protection.
 - ii. Over Voltage & Current: In addition, over voltage protection shall be provided between positive and negative conductor and earth ground such as Surge Protection Devices (SPD).
 - iii. PCU shall have arrangement for adjusting DC input current and should trip against sustainable fault downstream and shall not start till the fault is rectified.
 - iv. Galvanic Isolation: The PCU inverter shall have provision for galvanic isolation. Each solid-state electronic device shall have to be protected to ensure long life of the inverter as well as smooth functioning of the inverter.
 - v. Anti-islanding (Protection against Islanding of grid): The PCU shall have anti islanding protection. (IEEE 1547/UL 1741).
 - vi. Unequal Phases: The system shall tend to balance unequal phase voltage.
- PCU shall connect to tablet or mobile display screen and visualize/modify all the parameters through USB data cable or Bluetooth module or Wi-Fi module.
- PCU shall be provided with Mobile User interface facility for monitoring of its parameters by O&M personal for better O&M.
- PCU shall have AC and DC side monitoring capability and reporting to SCADA system (measured analog and digital value measured within PCU). Any special software if required for this purpose shall be provided for local and remote monitoring and report generation.
- The Supplier needs to submit the details earthing arrangement of PCU and system earth pit requirement.

Specific Requirement For String Inverter

- The string inverter enclosure protection class shall be IP 65 or better protection.
- String inverter shall have suitable communication port (Modbus RS485, Modbus TCP/IP and Power Line communication (PLC)) for SCADA integration. All necessary hardware, software and accessories used for communication with SCADA (including Data logger if supplied) at both the ends shall be provided by the manufacturer.
- String Inverter shall have string monitoring capability and reporting to SCADA system. Any special software if required for this purpose shall be provided for remote monitoring and report generation.
- The string inverter should have inbuilt Anti-PID Device. The Anti-PID function should work during the daytime also. Anti-PID Device along with all hardware and communication cable/device in a separate enclosure (IP 65 rating) may also be acceptable in case inbuilt features is not available in the string inverter. It is required in case negative grounding of PV string provision is not available in the inverters.
- Provision for AC electrical isolation device (such as MCB/MCCB/Isolator) inside string inverter shall be as per string inverter manufacturer's type tested design.



- AC isolators or Manual Call Points are required on the AC side in case the inverter are placed outdoor, before the AC combiner box. All isolators selected shall have the appropriate ampere rating for the Inverter output. The enclosure shall be of appropriate IP rating and be capable of 'Lock-Out, Tag-Out'. In case the inverters are placed indoor, the manual call points are required on the DC side.

Quality Assurance & Inspection

- Whenever the manufacturer / supplier is ready to carry out any such test and/or inspection, the manufacturer / supplier shall give 15 (fifteen) days advance notice of such test and/or inspection and of the place and time thereof to the client.
- The manufacturer / supplier shall provide all necessary facility including materials, tools, labour and assistance required for carrying out such inspection, testing and examination without any extra charges. The manufacturer / supplier shall also furnish the latest calibration certificate of the testing instruments/ Equipment used for the testing of the material/equipment/as covered in the contract, to the inspecting officer.
- Unless the inspection is specifically waived, no material shall be dispatched without prior inspection and clearance for dispatch by the client.
- The client also reserves the right to get the material/ equipment tested in any recognized APSR Approved Laboratory in the region and claiming any compensation or rejecting the material/equipment, if not found in accordance with the specification. All charges consequent to such erection and replacement / rectification shall be borne by the manufacturer or supplier.
- PCU manufacturer shall submit standard MQP/QAP for approval from the client. Any deviations, if raised shall be mutually agreed and justified.
- PCU to be supplied will be subjected to pre-shipment inspection by client or Third-Party Shipment Inspection as per sampling plan mutually agreed between concerned parties. During pre-shipment inspection, the quantity of products to be sampled and inspected shall be determined by mutual discussion as per relevant ISO. Samples shall be selected by the client or third-party inspectors from the entire lot.
- Tests at different stages of PCU manufacturing till the completion of the project as per approved MQP/QAP.
- Container loading check shall be performed to confirm that containers are loaded with the correct make & model of PCUs and that serial numbers of the PCUs loaded correspond with packing list and related documents, such documents shall be provided by the vendor prior to the container loading. The loading into the container is also verified in terms of loading method and usage of correct packaging materials. The placing of the container seal is observed and verified.

Testing

TYPE TEST

The Solar Inverters /P.C.U. offered shall be of Proven design and shall have been successfully type tested. All Type test certificates and reports for offered make and model of the equipment shall be furnished by the manufacturer. These type test reports shall not be more than five (5) years old, as on the date of issuance of RfP. If the manufacturer is not able to submit report of the type test(s) conducted within last five years from the date of issuance of RfP, or in the case of type test report(s) are not found to be meeting the specification requirements, the supplier shall conduct all such tests under this specification at no additional cost to the client and delivery impact either at third party Government recognized Approved Laboratory or in presence of client or its representative and submit the reports for approval.



FACTORY ACCEPTANCE TEST

Following is a list of desirable FAT. All the factory acceptance tests shall be performed as per the approved MQP/QAP and approved factory acceptance inspection procedure.

- i. Dimensional check on Enclosure
- ii. Paint Shade, Paint Adhesion & Thickness Check
- iii. Verification of Rating, Type, Make of all components as per BOM, Approved Drawings
- iv. Degree of Ingress Protection (IP) check
- v. Checking of doors and its handles alignment
- vi. Testing the functionality of door instrumentation, testing of cabinet heating Option
- vii. Uploading of Software to control board & checking of general parameter setting including protection setting
- viii. Control circuit function check including operation of contactors, relays & circuit breaker
- ix. Display panel functionality including Digital input/ Digital output
- x. Checking direction of rotation & ON-OFF control of the fans
- xi. Protection function check (by simulator or direct method) abnormal voltage & frequency, DC ground fault, DC reverse polarity, AC over/ under voltage, DC overvoltage, @Reactor over temperature, Negative Grounding
- xii. Calibration test (DC voltage, AC voltage & frequency)
- xiii. Testing of wake-up/ auto start & stop with grid connectivity
- xiv. Command Signal check/ Manual switching ON/OFF from PCU display panel with grid connectivity
- xv. Testing of the optional emergency stop circuit
- xvi. Maximum power point tracking test
- xvii. Demonstration of PCU operation at DC threshold voltage
- xviii. Heat Run Test for 08 Hours
- xix. Efficiency test including VCD, VAC, IAC, KWhr, KW, KVAR, KVARhr measurement at 10%, 20%, 50%, 70%, 100% Points
- xx. IR test on main & control Circuit
- xxi. HV test on main & control Circuit
- xxii. Harmonic Test at Rated load, ½ load and ¼ load
- xxiii. Power Factor Test
- xxiv. Earthing resistance measurement between moving parts and ground
- xxv. PV array insulation resistance Test
- xxvi. PV array residual current test
- xxvii. DC current injection test
- xxviii. Anti-islanding protection test
- xxix. Grid connection recovery test

Submission

The following list of documents to be submitted by the solar string inverter manufactures / vendor at different stages of procurement as mentioned below:

Stage	Document Name
Engg.	String Inverter standard Vendor Datasheet (signed & stamped copy)
Engg.	G.A. Drawing
Engg.	.OND File (with Third party verification Report)



Engg.	Key component list / specification / Make / life cycle
Engg.	Manufacturing Quality Plan (MQP)
Engg.	Quality Assurance Plan (QAP)
Engg.	Inverter & its component's Reliability Evaluation Report
Engg.	Temperature de-rating factor of main component
Dispatch	FAT Procedure & Report
Dispatch	Type Test Report
Engg.	Installation/User & O&M manual
Engg.	Independent test characteristics Inverter efficiency verses relative power Inverter efficiency versus temperature Annual efficiency verses sizing factor Total efficiency verses Standardized MPP power Temperature de-rating curve of the Inverter

Product Warranty

- The Manufacturers shall be legally bound to provide a performance guarantee ensuring that the equipment will be fully functional with desired output for 10 years from the date of commissioning.
- Consequently, irrespective of the manufacturer's guarantee to Supplier, the PCUs will be guaranteed for a minimum period of ten years. This warrantee will not be limited only for PCUs but will also include all associated accessories, instrumentation, and control.
- Manufacturer shall provide 99% uptime warranty for 10 years.
- It is essential that the product should give a consistent performance for 25 years life cycle of the project. The Manufacturer shall give an option of extended manufacturer's comprehensive warranties with onsite support beyond the guarantee period of 10 years. The Manufacturer is required to maintain adequate inventory spares in Oman during the product warranty period and extended warranty period. It is expected manufacturers shall provide satisfactory training to client's technical team at regular interval as decided mutually.

DC Protective Devices:

- If the selected Inverter is not equipped internally with a DC switch the Contractor shall supply an external switch rated adequately for maximum DC voltage and current.
- The DC Protection devices may be selected and designed from the brands accepted by Company as Per Approved list of makes
- If DC switches are used, they shall be capable of rapidly extinguishing an arc during the process of opening a DC circuit. Equipment designed for AC applications shall not be used in DC circuits.
- If DC fuses are used for the purposes of protecting against reverse currents, they shall be of appropriate ampere ratings to protect against overload of reverse current on the Solar Module strings. In the selection of the fuse size, the Contractor shall take into account the de-rating factors in the design calculations.
- All DC protective devices and other necessary components shall be housed in an appropriately sized enclosure. The enclosure shall be made of non-metallic, double insulated material or rated as a Class II appliance for electrical installation which does



not require a safety connection to the building earth. For outdoor applications, the protection class shall be IP65 as a minimum.

- Any DC switchboards shall be made of materials stable against UV for mechanical strength and discoloring by UV.

DC Cables

Cables shall be compliant to most recent standards (and latest amendments if any) developed by the IEC /Local standards or EN for UV resistant DC cables for solar PV applications. The table below presents a non-exhaustive list of standards to which cables should conform.

Applicable Standards & Codes

Standard	Description
EN 50618:2014 and IEC 60228, Class 5	Design & dimension of Tinned fine copper strands
IEC 60332-1	Fire performance
IEC 61034	Smoke emission
IEC 61537	Cable tray systems and cable ladder systems for cable management
IEC 60287	Conductor temperature
IEC 60216	Temperature index and service life of over 25 years
IEC 60754-1	Halogen-free
EN 50396	Ozone resistance
EN 50618 Annexure E	Weathering / UV resistance

Specific Design Requirements

In addition to the best manufacturing practices of manufacturers of cables, following are the specific requirements for all DC Solar cables unless anywhere specified:

- Cables should be solar grade, UV ozone, and high temperature resistant.
- Minimum 6 mm² DC Solar Cable to be considered.
- Y Connectors are not to be considered for wiring from Modules String to Inverter. Individually strings by MC4 Connectors to terminate at Inverter End.
- Cable shall be laid underground in double wall corrugated/ HDPE pipes.
- The cables shall be designed for a nominal DC voltage of 1.5 kV & max. DC voltage of 1.8KV with an operating temperature range of 0° C to 90° C
- The maximum conductor temperature shall not exceed 90°C during continuous operation at full rated current. The temperature after short circuit for 5 seconds shall not exceed 250° C with initial conductor temperature of 90° C.
- Manufacturers shall indicate the overload capacities that the cable can carry and its duration, when operating initially at a conductor temperature of 90° C, with a peak conductor temperature of 125° C.

General Requirement

- Conductors shall be fine wire strands of electrolytic grade high conductivity annealed tinned copper. Its grade shall be "A" & flexibility class will be 5.
- Conductors shall be multi-stranded, smooth, uniform in quality, and free from scale and other defects.
- Cables up to 6 mm² shall be of solar grade and have Insulation and the outer sheath shall be of high-grade XLPO compound. Material should be flame retardant & halogen-free. Its curing should be EBXL.



- Series connection of modules under the module (on purlin) so there is no hanging. Where cable is routed from rack-to-rack gap OR rack to ground shall be laid in appropriate UV protected conduits.
- Conduits shall be tied properly using UV protected ties. Extra length of ties to be cut after tightening.
- Separate conduit shall be used for both positive & negative DC cables.
- The cable ties shall be provided at appropriate distance so there shall be no Sagging as well as any tension on the cable. Unarmored cable should neither be exposed directly on ground nor on the structure should be under the purlin with proper tightening with cable ties or SS clamps as suitable.
- Cables shall be laid in underground trenches as per applicable OES & IEC standards with preference given to OEC standards.
- No. of cables in conduit shall not exceed 40% filling criteria. Current derating shall be calculated & considered for the same. In case of road crossing or water channel, NP3 Hume pipe shall be used considering 40% fill factor.
- Cables up to 6 mm² shall be tied along the solar PV module mounting structures, these cables are essentially required to be UV, ozone, and high temperature resistant. Only UV resistant cable ties shall be used in regular intervals.
- Cables connecting strings to SMBs or String Inverter shall be encased in flexible HDPE/ DWC pipes (unless it is armored type) while crossing two structures or laid underground. The pipes shall be UV resistant and Halogen free with withstanding temperature not less than 125°C.
- DC rated plug and socket connectors in case used for interconnecting harness to combiner boxes. These connectors shall be hermetically sealed with IP 68 class protection and double insulated.
- Cable sizing shall consider de-rating factors such as installation method, depth of installation, cable group factor, temperature effect etc. for optimized designs.
- Cable rolls shall be of minimum 1000 m, cabling shall be in uniform lengths with no joints. In standard erection practice of DC Cables, Cables shall be laid in complete lengths, uncut from one termination to another. No joints except end terminations are allowed.
- All DC cabling shall be provided with appropriate alphanumeric ferrules for easy identification of strings and further circuits at both ends. Ferrules quality and print should be able to sustain ambient conditions.
- Positively charged cables shall be colored red, negatively charged cables shall be colored black.
- Appropriate DC cable support system shall be selected and sized appropriately to cater for the corresponding number of DC cables. The selected material shall be resistant to effects of corrosion during the 25 years lifespan of the PV system.

Submission:

- GTP / QAT / FAT Plan & Reports
- Cable Cross-sectional drawing
- Type test certificates
- Conformity Certificate of compliance for applicable standard like IEC/TUV & etc.
- De-rating factor & Installation method

Makes - As per Annexure- A

Routine Test & Factory Acceptance Test - As per Annexure- B



DC Plug in Connectors for Field Cabling

Cable connector to be used for connecting SPV modules shall be in accordance with DIN EN 50521. Connector shall be of plug and socket design to be plugged together by hand but can be separated again using a tool only.

The section herein describes general specifications for Male/Female Connectors used for interconnecting Solar PV modules.

Applicable Standards & Codes:

Standard	Description
IEC 61730	PV component standards
IEC 62852:2014 /AMD1:2020 - Amendment 1	Connectors for DC-application in photovoltaic systems – Safety requirements and tests
UL 6703	The standard for Connectors for Use in Photovoltaic Systems
EN 50521 + A1	Safety requirements test
IEC 529	Degree of protection provided by enclosures
IEC 60352-2	Crimped connections – General requirements, test methods & practical guidance

Quality Certification For Connectors:

Connectors shall be compliant with the most recent standards (and latest amendments if any) developed by the IEC and EN. Regulations applicable in the area where equipment is to be installed shall be followed.

The below table presents a non-exhaustive list of standards to which connectors should conform.

Preference shall be given to manufacturers with maximum quality certifications for example by TUV, CE, UL, etc.

General Requirement

- Connectors shall be over molded type ready to plug. Connectors shall be suitable for ambient temperature range of -40°C to 90°C and upper limiting temperature shall be 125°C when connected and humidity of 95%.
- Rated voltage of Male/ Female connectors shall be 1500V DC.
- The connectors shall be rated at 30A continuous current & suitable for 6 mm² solar cable (designed as per EN-50618).
- The connectors shall be MC4 compatible type however final confirmation on connector compatibility with module to be provided during detailed engineering.
- The connectors shall be tested at 8kV AC voltage, 50Hz for one minute.
- The connectors shall be the same make as the connectors provided on the module cables. In case of exceptions, upon Company approval, the connectors used for the interconnection of the solar panels shall be tested for compatibility to the connectors' make used in the modules.

Specific Construction Requirement

- The connector shall be snap in locking type made up of Polycarbonate/ Polyamide material suitable for outdoor applications with IP68 protection rating when in mated condition.
- The connector shall be ozone resistant, halogen free, dust proof, non-conductive UV resistant, with high inflammability value.
- Insulating material should be PPE / Noryl / Polycarbonate / Polyamide.
- Heat & Fire resistance category shall be as per UL94 -V0.



- The Connector system should be compatible to the PV module's connectors and shall confirm EN50521+A1.
- Contact material shall be tin plated copper alloy with multi-contact technology.
- System shall be designed for minimum contact resistance between connectors.
- Contact resistance at termination shall be or below 0.25 milli-ohms (typical).
- The connectors shall be provided with over voltage category - III/pollution degree of 3.
- Minimum safety class-II shall be considered for connectors.
- The connectors shall be suitable for crimped design at site with 6 sqmm solar DC cables.
- Connectors shall have good resistance to ammonia and shall also pass salt mist spray test.
- Contractor to ensure installation is strictly in line with installation manual.

Submission

- Contractors shall submit following documents from Manufacturer/ Supplier.
- Compatibility Report to be submitted with PV Module and SMB / String Inverters side connectors
- GA, GTP, QAP and FAT report
- Quality certifications by TUV or UL.
- Technical literature giving complete product specifications.
- BOM / Makes and specifications, Certifications of all components.

Makes - As per Annexure- A

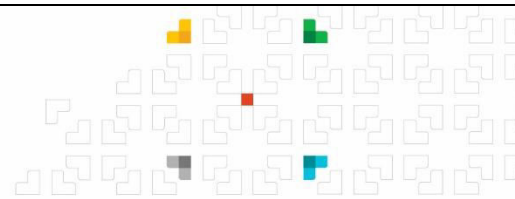
Routine Test & Factory Acceptance Test - As per Annexure- B

AC Cables (1.1 kV AND 1.9/3.3 kV):

The cables shall be compliant to most recent standards (and latest amendments if any) developed by the IEC/Local Standards. The table below presents a non-exhaustive list of standards to which the cables should conform.

Applicable Standards & Codes

Standard	Description
IEC 60502	Recommended current ratings for cables
IEC 60840	XLPE Insulated PVC Sheathed Cables for Working Voltages <1100V
IEC 60227 & 60228	Conductors for insulated cables
BS 6346	PVC insulated (heavy duty) electric cables for working voltage up to and including 1100 V
IEC-754 (Part-I)	Tests on gases evolved during combustion of electric cables
ASTM-O -2843	Standard test method for density of smoke from the burning or decomposition of plastics
IEC-332	Tests on electric cables under fire conditions. Part-3: Tests on bunched wires or cables (Category-B)
IEC 60885	Methods of tests for cables
IEC 230	Impulse tests on cables and their accessories
IEC 60331	Tests for electric cable under fire conditions
IEC 60332	To meet flame propagation





Specific Design Requirements

- Cables sizes shall be selected considering the power loss, current carrying capacity, voltage drop, maximum short circuit duty and the period of short circuit, to meet the anticipated currents.
- High quality XLPE insulating compound of natural Colour shall be used for insulation. Insulation shall be applied by triple extrusion process and shall be chemically cross linked.
- Cables shall be 1.1 kV or 1.9/ 3.3 kV grade, single/ multi core, extruded XLPE insulated with extruded PVC inner sheath (ST-2), single wire or strip Armoured (as per requirement) & extruded (ST-2) PVC outer sheath. Also, outer sheath shall have UV and Ozone resistance properties for outdoor installation and Anti-termite and Anti-rodent properties in case of buried installation.
- The conductor shall be high conductivity annealed Copper and shall be smooth, uniform in quality and free from scale and any defects.
- The maximum conductor temperature shall not exceed 90°C during continuous operation at full rated current. The temperature after short circuit for second shall not exceed 250°C with initial conductor temperature of 90°C.
- Cables shall be armoured with mild steel wires or strips.
- The outer sheath shall be of suitable grade PVC (ST-2). Compound applied by extrusion process. Colour of the outer sheath shall be black.
- Buried Application & Indoor Application Cable will be FRLS type.

Cabling

- Cables shall be laid in underground trenches as per applicable OES & IEC standards with preference given to OEC standards
- Cables shall be laid in NP3 hume pipes at all road crossings. After the laying and straightening of cables, it should be covered with a min 100 mm thick layer of sand. Necessary blasting to be done for digging the rocky soil for road crossing.
- All cable terminations shall be mechanically and electrically sound and shall comply with relevant IEC standards and Oman electricity regulations.
- Cable samples shall be taken and tested from each lot for ascertaining the conformity of the lot to the requirements of the specification.
- AC side Cabling between the inverters to Inverter Duty transformer shall be rated for 1.9/3.3 kV.
- Single core Copper cables in trefoil arrangement (as per Inverter manufacturer recommendation guidelines) shall be used from String Inverter Combiner Panel to the Inverter Duty transformer.

Cable Identification:

Cable identification shall be provided by embossing on every one meter on the outer sheath the following:

- Manufacturer's name or trademark
- Voltage grade
- Year of manufacture
- Type of insulation
- No. of core and size of cables

Submission

- The Contractors shall submit manufacturer's documents for all the cables.



- GTP / Cross section drawing / QAP / FAT procedure & Test reports
- Manufacturer/ Supplier shall submit type test certificates issued by a National or International Testing Authority.
- Following the award of contract, Contractor shall supply type non-exhaustive test reports of each of the cable types.

Makes - As per Annexure- A

Routine Test & Factory Acceptance Test - As per Annexure- B

Medium Voltage AC Cables (11 kV Cables)

The cable shall be 11 kV Grade, high conductivity stranded compacted circular conductor, Copper material, tapped with semiconducting, 3 core, XLPE insulated, inner PVC sheathed, galvanized steel strip armoured with overall separate extruded PVC outer sheath, conforming generally to IEC-60502 & OES Standards and latest amendment there of suitable for 11 kV, 3 phase, 50 Hz unearthed system.

Quality Certification

Cables shall be compliant to most recent standards (and latest amendments if any) developed by the IEC /OES Standards. Table below presents a non-exhaustive list of standards to which the cables should conform.

Applicable Standards & Codes:

Standard	Description
IEC 60502	Recommended current ratings for cables
IEC 60227 & 60228	Conductors for insulated cables
IEC-754 (Part-I)	Tests on gases evolved during combustion of electric cables
ASTM-O -2843	Standard test method for density of smoke from the burning or decomposition of plastics
IEC-332	Tests on electric cables under fire conditions. Part-3: Tests on bunched wires or cables (Category-B)
IEC 60885	Methods of tests for cables
IEC 230	Impulse tests on cables and their accessories

Specific Design Requirements:

- Cables sizes shall be selected considering the power loss, current carrying capacity, voltage drop, maximum short circuit duty and the period of short circuit should be in line with findings of the listed studies by OETC/APSR/Distribution Companies.
- The conductor shall be high conductivity Copper. It should be smooth, uniform in quality and free from scale and any defects.
- Armoring shall be of galvanized steel wires for Multicore cables.
- Two distinct sheaths i.e. Inner and outer shall be provided. Outer sheathing shall be designed to afford high degree of mechanical protection and shall also be heat, oil, chemicals and weather resistant and saline solution shall not have adverse effect on the material used for PVC outer sheathing. Outer sheath and inner sheath shall be of suitable grade PVC compound applied by extrusion process. Colour of the outer sheath shall be black.
- The cable shall withstand all mechanical and thermal stresses under steady state and transient operating conditions. Cables shall be laid in accordance with relevant IEC guidelines.

Buried Application & Indoor Application Cable will be FRLS type.

- The outer sheath shall also have Anti-rodent/ Anti-termite properties. The Outer sheath



- shall have Anti-UV and Anti-ozone for outdoor cable laying in air on cable rack / tray.
- The maximum conductor temperature shall not exceed 90°C during continuous operation at full rated current. The temperature after short circuit for 1 second shall not exceed 250°C (for XLPE).
 - The HT cable should be suitable for Grid Substation Voltage UE rating as per design.
 - Sequential marking of length of cables shall be provided on outer sheath at every one meter.
 - Allowable tolerances on the overall diameter of the cables shall be ± 2 mm maximum over the declared value in the technical data sheets.
 - In plant repairs to the cables shall not be accepted. Pimples, fish eye, blow holes etc. are not acceptable.
 - The cables shall be suitable for laying in trays, RCC trenches, ducts and conduits installation PVC/ Rubber end caps shall be supplied free of cost for each drum. In addition, ends of the cables shall be properly sealed with caps to avoid ingress of water during transportation and storage.

Conductor

The conductor shall be made from stranded very well compacted, round conductor shall be class -2 Copper conductor as per latest IEC – 60228.

Conductor Shield

The conductor shall have a semi-conducting screen, which will ensure perfectly smooth profile to avoid stress concentration. The conductor screen shall be extruded in the same operation as the insulation.

Insulation

The XLPE insulation shall be suitable for specified 11 kV system voltage. The manufacturing process shall ensure that insulation shall be free from voids. The insulation shall withstand mechanical and thermal stresses under steady state and transient operating conditions. The extrusion method shall give very smooth interface between semi-conducting screen and insulation. The insulation of the cables shall be of high standard quality and conform to IEC-60502 part -II or latest amendment thereof.

Insulation Shield

To confine electrical field to the insulation, insulation screening consisting of two parts, namely metallic (non-magnetic) and non-metallic (semi conducting) shall be provided. The non-metallic semi-conducting shield shall be put over the insulation of each core. The insulation shield shall be extruded in the same operation as the conductor shield and the insulation by triple extrusion process. The insulation shield shall be bonded and Strippable, on adequate heat treatment. Metallic shield shall be provided over nonmetallic portion as per provision of IEC-60502 part -II or latest amendment thereof.

Inner Sheath

The sheath shall be suitable to withstand the operating conditions and the desired temperature rating of the cable. It shall be of adequate thickness, consistent quality and free from all defects.

Armour

Galvanized steel strip armouring shall be provided. The dimensions of steel strip shall be as per IEC and its latest amendment and strip shall conform to latest provisions of IEC and amendment thereof.

Outer Sheath

Extruded PVC outer sheath of type ST-2 as per IEC: 60502 part -II and its latest amendment shall be applied over armouring with suitable additives to prevent attack by rodent and termite



and its thickness shall be in accordance with IEC and latest amendment thereof. It shall have Anti-UV and Anti-ozone properties.

Construction

- The cable shall have suitable PVC fillers laid up with insulated cores to provide substantially circular cross section before the inner sheath is applied. The fillers shall be suitable for operating temperature of the cable and compatible with the insulating material.
- All materials used in the manufacture of cable shall be new, unused and of finest quality. All materials shall comply with the applicable provisions of the tests of the specification, IEC and any other applicable statutory provisions, rules, and regulations.
- The PVC material used in the manufacture of cable shall be of reputed make. No recycling of the PVC is permitted. The purchaser reserves the right to ask for documentary proof of the purchase of various materials to be used for the manufacture of cable and to check that manufacturer is complying with quality control.

Workmanship And Quality Assurance

The workmanship shall be neat, clean and of highest grade/quality.

Current Rating

- The cable will have current rating and de-rating factors as per relevant IEC Standards.
- The current rating shall be based on maximum conductor temperature of 90°C with ambient site condition specified in General Requirement of Specification for continuous operation at the rated current.

Operation

- Cable shall be suitable for laying in ducts, Cable Trays (ladder type with cover/canopy) and direct in ground.
- Cables shall have heat and moisture resistant properties. These shall be of type and design, with proven record of distribution network service.

Lengths

- The cables shall be supplied in drum lengths of 1000 M or required as per site condition. Any joints in the feeder must be done using MV Splicing Cabinet over the surface.

Cable Selection & Sizing

- HT cables shall be sized based on the following considerations:
 - Rated current of the equipment
 - Short circuit withstand capability-
 - Fault current - As specified in HT switchgear system.
 - Time – As per protection time grading requirement subject existing scheme at the time of detailed engineering.
- Derating factors:
 - De rating factors for various conditions of installations including the following shall be considered while selecting the cable sizes:
 - Variation in ambient temperature for cables laid in air
 - Grouping of cables
 - Variation in ground temperature and soil resistivity for buried cables.

Cabling

- The cables laid above the ground shall be in the cable trays.
- Cables shall be laid in underground trenches as per applicable OES & IEC standards with preference given to OEC standards.



- At road crossing, Hume pipe of NP3 class shall be used with joints sealed using collar and cement concrete. Necessary blasting work to be done for digging the soil.
- Cable routes, if provided by client must be adhered to unless any site specific challenge is identified.
- All cable terminations shall be mechanically and electrically sound and shall comply with relevant IEC standards and Oman electricity regulations.
- Cable samples shall be taken and tested from each lot for ascertaining the conformity of the lot to the requirements of the specification.

Cable Identification

- Cable identification shall be provided by embossing on every one meter on the outer sheath the following:
- Manufacturer's name or trade mark
- Voltage grade
- Year of manufacture
- Type of insulation
- No. of core and size of cables

Submission

- The Contractor s shall submit manufacturer's documents for all the cables.
- GTP / Cross section drawing of cable
- QAP
- FAT procedure & FAT Report
- Manufacturer/ Supplier shall submit type test certificates issued by a National or International Testing Authority.

Makes - As per Annexure- A

Routine Test & Factory Acceptance Test - As per Annexure- B

LT Panels and ACDB

All the switchboards shall be compliant to most recent standards (and latest amendments if any) developed by the IEC, OES and EN. Regulations applicable in the area where equipment is to be installed shall be followed.

The below table presents a non-exhaustive list of standards to which switchboards should conform.

Standard	Description
IEC 60947	Low Voltage AC Switchgear and Control Gears Specifications
IEC 60529	Degree of protection for enclosures for low voltage switchgear and control gear
IEC 60528	Degree of protection provided by enclosures
IEC 60404	Electrolytic Copper
IEC 60439	Circuit Breakers, voltages up to 1000 Volts
IEC EN 60269-1	Air Break Switches, Air Break Disconnectors, for voltages not exceeding 1000 V AC.
IEC 60529	Marking & Arrangement for Switchgear, Bus Bars, main connections, and auxiliary wiring.
IEC 61439-1	Low-voltage switchgear and control gear assemblies - Part 1: General rules
IEC 61439-2	Low-voltage switchgear and control gear assemblies -



Standard	Description
	Part 2: Power switchgear and control gear assemblies
IEC 62052-11	Electricity metering equipment (a.c.) - General requirements, tests, and test conditions - Part 11: Metering equipment
IEC 60445	Basic and safety principles for man-machine interface, marking and identification - Identification of equipment terminals, conductor's terminations and conductors
IEC 60255	Measuring relays and protection equipment - Part 1: Common requirements
IEC 60439	Low-voltage switchgear and control gear assemblies
IEC 60364	Electrical installations of buildings
IEC 61869	Instrument Transformers
IEC 62056	AC Electric Meters
IEC 61557	Electrical safety in low voltage distribution systems up to 1000 V a.c. and 1500 V d.c.
IEC 61643	Low-voltage surge protective devices - Surge protective devices connected to low-voltage power systems
IEC 60947-2	Danger Notice Plates
IEC 62626-1	Low-voltage switchgear and controlgear enclosed equipment - Part 1: Enclosed switch-disconnectors outside the scope of IEC 60947-3 to provide isolation during repair and maintenance work

General

All the AC low voltage switchboards shall be suitable for operation with 415 V & 800V, 50 Hz and 3/4 wire system. The overall construction of the LV Switchboards shall be factory assembled with fabrication processed on CNC type or equivalent machines.

Construction

- The switch boards shall be dead front totally enclosed; cubicle type suitable for floor mounted free standing/ wall mounted indoor installations. The design shall be totally dust - tight damp - proof and vermin proof offering degree of protection not less than IP-42 for indoor applications. For outdoor applications, the protection class shall be IP65 as a minimum.
- The panel shall be fabricated from 2 mm CRCA sheet steel for frame & load bearing surfaces. Partitions may be fabricated from 1.6 mm CRCA if no components are mounted on them.
- Floor mounted cubicles shall be provided with a 50 mm/75 mm high channel base frame.
- Total height of the cubicle shall not exceed 2400 mm, keeping in view the operating height of top switch should not exceed 1750 mm from floor level including base channel.
- The switchboards shall be of bolted design. The complete structures shall be rigid, self-supporting, and free from flaws, twists and bends. All cutouts shall be true in shape and devoid of sharp edges.
- Switchboards shall be supplied with base frames made of structural steel sections, along with all necessary mounting hardware required for welding down the base frame to the foundation / steel insert plates.



- All equipment and components shall be neatly arranged and shall be easily accessible for operation and maintenance. Replacement /Maintenance of individual equipment/ component shall be possible without switching off or isolating the other equipment's/ components.
- Each switchboard shall be provided with an undrilled, removable type gland plate. For all single core & multicore cables, gland plate shall be of non-magnetic material. The gland plate shall be provided with gasket to ensure enclosure protection.
- All panel edges and cover / door edges shall be reinforced against distortion by rolling, bending or by the addition of welded reinforcement members. The top covers of the panels should be designed such that they do not permanently bulge/ bend by the weight of maintenance personnel working on it.
- Adequate size cable compartment should be provided for easy clamping of all the incoming and outgoing cables irrespective of top or bottom entries.
- All live parts inside the switchboards shall be insulated and shall withstand a DC test voltage of 2.5 kV for 1 minute. Switchboards shall carry a warning label indicating that all active parts in the boxes may be live.
- All MFMs (if applicable) shall be of digital electronic with LED display and shall have RS-485 port for SCADA communication.
- The minimum clearance in air between phases and between phases and earth for the entire busbars shall be 25mm. For all other components, the clearance between "two live parts", "a live part and an earthed part", shall be at least ten (10) mm throughout. Wherever it is not possible to maintain these clearances, insulation shall be provided by sleeving or barriers. However, for busbars the clearances specified above should be maintained even when the busbars are sleeved or insulated. All connections from the busbars up to switch / fuses/MCCB shall be fully insulated and securely bolted to minimize the risk of phase to phase and phase to earth short circuits. All busbars and jumper connections shall be of high conductivity copper of adequate size. LT Panels shall be followed by Form 4b as per IEC 61439.
- 415V switchboards shall be provided with three phase and neutral busbars & 800V switchboards shall be provided with three phase.
- Entire busbar system shall be insulated with PVC sleeves. Busbar sleeves shall be compliant to UL224 (Extruded insulating tubing), CE/UL certified, having fire retardant properties, and a working temperature of 105°C.
- The cross-section of the busbars shall be uniform throughout the length of switchboard section and shall be adequately supported and braced to withstand the stresses due to the specified short circuit currents. Neutral busbar short circuit strength shall be same as main busbars.
- All busbars shall be adequately supported by non-hygroscopic, noncombustible, track-resistant and high strength sheet molded compound or equivalent type polyester fiber glass molded insulator. Separate supports shall be provided for each phase and neutral busbar. If a common support is provided, anti-tracking barriers shall be provided between the supports.
- Insulator and barriers of inflammable material such as Hylam shall not be accepted. The busbar insulators shall be supported on the main structure.
- All busbar joints shall be provided with high tensile steel bolts, belleville / spring washers and nuts, so as to ensure good contacts at the joints. Nonsilver plated busbar joints shall be thoroughly cleaned at the jointed locations and suitable contact grease shall be



applied just before making a joint. All bolts shall be tightened by torque spanner to the recommended value. The overlap of the busbars at each joint surface shall be such that the length of overlap shall be equal to or greater than the width of the busbar.

- Wherever the busbars are painted with black Matt paint, the same should be suitable for temperature encountered in the switchboard under normal operating conditions.
- The Contractor shall furnish calculations establishing the adequacy of bus bar sizes for specified current ratings.
- Panel space heaters shall be provided and the supply for this shall be tapped from incomer, before the isolating switch/circuit breaker. Incoming circuit to space-heater shall have an isolating switch, HRC fuse and neutral link of suitable rating. Panel illumination and plug-socket shall also be tapped from the space heater supply.
- A Copper earth bus shall be provided at the bottom of each panel and shall extend throughout the length of each switchboard. It shall be welded / bolted to the framework of each panel and breaker earthing contact bar. Vertical earth bus shall be provided in each vertical section which shall in turn be bolted / welded to main horizontal earth bus.
- The earth bus shall have sufficient cross section to carry the momentary short circuit and short time fault current to earth without exceeding the allowable temperature rise.
- All non-current carrying metal work of the switchboard shall be effectively bonded to the earth bus. Electrical conductivity of the whole switchgear enclosure framework and truck shall be maintained even after painting.
- All metallic cases of relays, instruments and other panel-mounted equipment shall be connected to earth by independent stranded copper wires of size not less than 2.5 sq. mm. All the equipment mounted on the door shall be earthed through flexible wire/braids. Insulation color code of earthing wires shall be green. Earthing wires shall be connected to terminals with suitable clamp connectors, soldering is not acceptable.
- Looping of earth connections, which would result in loss of earth connections to other devices, when a device is removed, is not acceptable. However, looping of earth connections between equipment to provide alternative paths to earth bus is acceptable.
- All hinged doors having potential carrying equipment mounted on it shall be earthed by flexible wire/ braid. For doors not having potential carrying equipment mounted on it, earth continuity through scraping hinges/ hinge pins of proven design may also be acceptable. The Contractor shall establish earth continuity at site also.
- All switchboards shall be supplied completely wired internally up to the terminals, ready to receive external cables.
- All auxiliary wiring shall be carried out with 1100 V grade, single core stranded copper conductor, colour coded, PVC insulated wires. Conductor size shall be 1.5 mm² (min.) for control circuit wiring and 2.5 mm² (min) for CT and space heater circuits.
- Extra flexible wires shall be used for wiring to devices mounted on moving parts such as hinged doors. The wire bunches from the panel inside to the doors shall be properly sleeved or taped.
- All wiring shall be properly supported, neatly arranged, readily accessible and securely connected to equipment terminals and terminal blocks.
- All internal wiring terminations shall be made with solderless crimping type tinned copper lugs which shall firmly grip the conductor or an equally secure method. Similar lugs shall also be provided at both ends of component to component wiring. Insulating sleeves shall be provided over the exposed parts of lugs to the extent possible. Screw-less (spring loaded) / cage clamp type terminal shall also be provided with lugs.



- Printed single tube ferrules marked to correspond with panel wiring diagram shall be fitted at both ends of each wire. The wire identification marking shall be in accordance with IEC / OES Standard. Red Ferrules should be provided on trip circuit wiring.
- Cable termination arrangement for power cables shall be suitable for heavy duty, 1.1 and 1.9/3.3 kV grade, stranded Copper conductor, PVC/ XLPE insulated, armoured / unarmoured and PVC sheathed cables. All necessary cable terminating accessories such as supporting clamps and brackets, hardware etc., shall be provided by the contractor to suit the final cable sizes.
- All power cable terminals shall be of stud type and the power cable lugs shall be of tinned copper solderless crimping ring type conforming as per relative IEC standard. All lugs shall be insulated/ sleeved.
- All Switchgears, MCCBs, Distribution Boards, Fuse boards, all feeders, local push-button stations etc. shall be provided with prominent, engraved identification plates.
- All name plates shall be of non-rusting metal or 3-ply Lamicoid, with white engraved lettering on black background. Inscription & lettering sizes shall be subject to Client's approval.
- Caution name plate "Caution Live Terminals" shall be provided at all points where the terminals are likely to remain live and isolation is possible only at remote end.
- The gaskets, wherever specified, shall be of good quality EPDM / neoprene with good ageing, compression and oil resistance characteristics suitable for panel applications.
- The contractor shall, ensure that the equipment offered will carry the required load current at site ambient conditions specified and perform the operating duties without exceeding the permissible temperature as per IEC standards / specification. Continuous current rating at 50 deg C ambient in no case shall be less than 90% of the normal rating specified.
- ON/OFF status and protection trip status of incomers and bus coupler (if available) be provided for SCADA system.
- Suitable changeover and interlocking arrangement shall be provided for incomers and bus coupler.
- It shall be the responsibility of the contractor to fully coordinate the overload and short circuit breakers/fuses with the upstream and downstream circuit breakers / fuses, to provide satisfactory discrimination.
- Further the various equipment supplied shall meet the requirements of Type II class of co-ordination.

MCCB

- MCCB shall have microprocessor-based release only. MCCB shall have $I_{cs} = I_{cu} = 100\%$ at rated voltage & frequency.
- MCCB shall be fixed type module, air break type, having trip free mechanism with quick make and quick break type contacts. MCCB shall have current limiting feature. MCCB of identical ratings shall be physically and electrically interchangeable. MCCB shall be provided with 1 NO and 1NC auxiliary contacts.
- MCCB shall have inbuilt front adjustable releases (overload & short circuit) and shall have adjustable earth fault protection unit also. The protection settings shall have suitable range to achieve the required time & current settings. LED indications shall also be provided for faults, MCCB status (on/off/trip etc).
- MCCB terminals shall be shrouded and designed to receive cable lugs for cable sizes relevant to circuit rating. Extended cable terminal arrangement for higher size cable may



also be offered. ON and OFF position of the operating handle of MCCB shall be displayed and the rotary operating handle shall be mounted on the door of the compartment housing MCCB. The compartment door shall be interlocked mechanically with the MCCB, such that the door cannot be opened unless the MCCB is in OFF position. Means shall be provided for defeating this interlock at any time. MCCB shall be provided with padlocking facility to enable the operating mechanism to be padlocked.

- The MCCBs being offered shall have common/interchangeable accessories for all ratings like aux. switch, shunt trip, alarm switch etc.
- The MCCBs shall have the current discrimination up to full short circuit capacity and shall be selected as per manufacturer's discrimination table.
- MCCB with LSIG protection and current limiting feature shall be provided for aux. transformer protection (where input supply is tapped from inverter transformer's LV side), main incomer of LT Panel, UPS feeder, Battery charger feeder, supply to other inverter room, transformer oil filtration machine load etc as per requirement.

Busbar Compartment:

A completely enclosed bus bar compartment shall be provided for the horizontal and vertical busbars. Bolted covers shall be provided for access to horizontal and vertical busbars and all joints for repair and maintenance, which shall be feasible without disturbing any feeder compartment. Auxiliary and power busbars shall be in separate compartments.

Switchgear / Feeder Compartment:

All equipment associated with a feeder shall be housed in a separate compartment of the vertical section. ACB shall be provided for feeders of rating 1000A and above. The design of the vertical section for such an arrangement shall ensure ease of termination of power cables of size & quantity as per system requirement. The compartment shall be sheet steel enclosed on all sides with the withdrawable units in position or removed. Insulating sheet at rear of the compartment is also acceptable. The front of the compartment shall be provided with the hinged single leaf door with captive screws for positive closure.

Cable Compartment/Cable Alley:

A full-height vertical cable alley of minimum 250mm width shall be provided for power and control cables. Cable alley shall have no exposed live parts and shall have no communication with busbar compartment. Cable terminations located in cable alley of capacity more than 400 A shall be designed to meet the Form IV b (as per IEC 61439) for safety purpose. Wherever cable alleys are not provided for distribution boards, segregated cable boxes for individual feeders shall be provided at the rear for direct termination of cables. For circuit breaker external cable connections, a separately enclosed cable compartment shall also be acceptable. The contractor shall furnish suitable plugs to cover the cable openings in the partition between feeder compartment and cable alley. Cable alley door shall be hinged.

Control Compartment:

- A separate compartment shall be provided for relays and other control devices associated with a circuit breaker.
- All switchboards shall be of dust-proof and vermin-proof construction and shall be provided with a degree of protection of IP: 4X as per IEC 60947.
- Provision of louvers on switchboards would not be preferred. However, louvers backed with metal screen are acceptable on the busbar chambers.
- Sheet steel barriers shall be provided between two adjacent vertical panels running to the full height of the switchboard, except for the horizontal busbar compartment. EPDM / Neoprene gasket shall be provided between the panel sections to avoid ingress of dust



into panels.

- The minimum clearance in air between phases and between phases and earth for the entire busbars and bus-link connections at circuit-breaker shall be 25mm. All busbars and jumper connections shall be of high conductivity copper of adequate size.
- After isolation of power and control circuit connections it shall be possible to safely carryout maintenance in a compartment with the busbar and adjacent circuit live. Necessary shrouding arrangement shall be provided for this purpose. Wherever two breaker compartments are provided in the same vertical section insulating barriers and shrouds shall be provided in the rear cable compartment to avoid accidental touch with the live parts of one circuit when working on the other circuit.
- All switchgear (circuit-breaker) panels shall be of single-front type. The covers shall be provided with "DANGER" labels. All panel doors shall open by 90 deg or more.
- All circuit-breaker modules shall be of fully draw out type having distinct 'Service' and 'Test' positions. Suitable arrangement with cradle / rollers, guides along with tool / lever operated racking in / out mechanism shall be provided for smooth and effortless movement of the chassis.
- The module identification plate shall clearly give the feeder number and feeder designation. For single front switchboards, similar panel and board identification labels shall be provided at the rear switchgear also.
- The carriage and breaker frame shall get earthed while being inserted in the panel and positive earthing of the breaker frame shall be maintained in all positions, i.e. SERVICE & ISOLATED, as well as throughout the intermediate travel.
- Electrically controlled circuit breaker boards shall be provided with DC control supply.
- The enclosure shall be of appropriate IP rating and be capable of 'Lock-Out, Tag-Out'.

Air Circuit Breakers

- Circuit breakers shall be three pole, air break, horizontal draw out type, and shall have fault making and breaking capacities as specified in "Technical Parameters". The circuit breakers which meet specified parameters of continuous current rating and fault making / breaking capacity only after provision of cooling fans or special device shall not be acceptable.
- Circuit breakers along with its operating mechanism shall be provided with suitable arrangement for easy withdrawal. Suitable guides shall be provided to minimize misalignment of the breaker.
- There shall be "SERVICE", "TEST" and "FULLY WITHDRAWN" positions for the breakers. In "Test" position the circuit breaker shall be capable of being tested for operation without energizing the power circuits i.e. the power contacts shall be disconnected, while the control circuits shall remain undisturbed. Locking facilities shall be provided so as to prevent movement of the circuit breaker from the "SERVICE", "TEST" or "FULLLY WITHDRAWN" position. Circuit Breaker rack-in and rack-out from Service to Test, Test to Isolated position, or vice-versa shall be possible only in the compartment door closed condition.
- Separate limit switches, each having required numbers of contacts shall be provided in both "SERVICE" and "TEST" position of the breaker. All contacts shall be rated for making, continuously carrying and breaking 10 Amp at 240 V AC and 1 Amp (Inductive) at 240 V DC respectively.

Suitable mechanical indications shall be provided on all circuit breakers to show "OPEN", "CLOSE", "SERVICE", "TEST" AND "SPRING CHARGED" positions.



- Main poles of the circuit breakers shall operate simultaneously in such a way that the maximum difference between the instants of contacts touching during closing shall not exceed half a cycle of rated frequency.
- Movement of a circuit breaker between "SERVICE" and "TEST" position shall not be possible unless it is in open position. Attempted withdrawal of a closed circuit breaker shall preferably not trip the circuit breaker. In case the offered circuit breaker trips on attempted withdrawal as a standard interlock, it shall be ensured that sufficient contact exists between the fixed and draw out contact at the time of breaker trip so that no arcing takes place even with the breaker carrying its full rated current.
- Closing of a circuit breaker shall not be possible unless it is in "SERVICE" position, "TEST" position or in "FULLY WITHDRAWN" position.
- Circuit-breaker cubicles shall be provided with safety shutters operated automatically by the movement of the circuit breaker carriage, to cover the stationary isolated contacts when the breaker is withdrawn. It shall however be possible to open the shutters intentionally against pressure for testing purposes.
- Breaker of particular rating shall be prevented from insertion in a cubicle of a different rating.
- Circuit breakers shall be provided with coded key / electrical interlocking devices, as per requirements.
- Circuit breaker shall be provided with anti-pumping feature and trip free feature, even if mechanical anti-pumping feature is provided.
- Mechanical tripping shall be possible by means of front mounted Red "trip" push-button. In case of electrically operated breakers these push buttons shall be shrouded to prevent accidental operation.
- Complete shrouding / segregation shall be provided between incoming and outgoing bus links of breakers. In case of bus coupler breaker panels, the busbar connection to and from the breaker terminals shall be segregated such that each connection can be approached and maintained independently with the other bus section live. Dummy panels if required to achieve the above feature shall be included in the Contractor's scope of supply.
- Circuit breaker open/close shall be possible from SCADA and open/close status and all other important signal status shall be provided for SCADA monitoring.
- Power operated mechanism shall be provided with a Universal motor suitable for operation on DC Control supply. In case of DC supply motor should satisfactorily operate with voltage variation between 85% to 110% nominal control supply voltage. Motor insulation shall be class "E" or better.
- The motor shall be such that it requires not more than 30 Seconds for fully charging the closing spring at minimum available control voltage.
- Once the closing springs are discharged, after one closing operation of circuit breaker, it shall automatically initiate recharging of the spring.
- The mechanism shall be such that as long as power is available to the motor, a continuous sequence of closing and opening operations shall be possible. After failure of power supply at least one open-close-open operation shall be possible.
- Provision shall be made for emergency manual charging and as soon as this manual charging handle is coupled, the motor shall automatically get mechanically decoupled.
- All circuit breakers shall be provided with closing and trip coils. The closing coil shall operate correctly at all values of voltage between 85% to 110% nominal control supply



voltage. The trip coil shall operate satisfactorily at all values of voltage between 70% to 110% nominal control supply voltage.

- Provision for mechanical closing of the breaker only in "TEST" and "WITHDRAWN" positions shall be made. Alternately, the mechanical closing facility shall be normally made inaccessible; accessibility being rendered only after deliberate removal of shrouds.
- The ACB Panel door shall not be possible to open in breaker closed condition. Further, the racking mechanism shall be accessible only after opening the breaker panel door.
- Telescopic trolley or suitable arrangement shall be provided for maintenance of circuit-breaker module in a cubicle at each location. The trolley shall be such that the top most breaker module can be withdrawn on the trolley and can be lowered for maintenance purpose. The telescopic trolley shall be such that all type, size and rating of breaker can be withdrawn /inserted of particular switchgear.
- Short time withstand will be as per System Fault current calculation by Software like Etap.

Submission

- The Contractor s shall submit manufacturer's documents for all the cables.
- GTP / GA / Electrical Schematic drawings and design calculations
- QAP
- FAT procedure & FAT Report
- Manufacturer/ Supplier shall submit type test certificates issued by a National or International Testing Authority.

Makes - As per Annexure- A

Routine Test & Factory Acceptance Test - As per Annexure- B

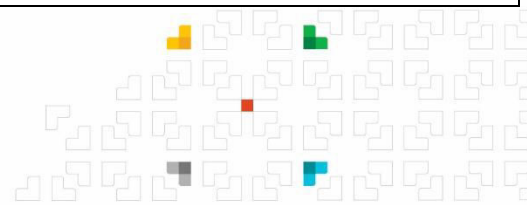
Inverter Duty Transformers

Contractor to propose a group of inverters to form a block having one IDT. Each shall step up the low voltage post inverter to Grid substation voltage. The transformers shall have off-circuit tap changer for a range of -5% to +5% @ step of 2.5%.

Applicable Standard:

All standards, specifications and codes of practice referred to herein shall be the latest editions including all applicable official amendments and revisions as on date. The following standards and codes shall be applicable:

Standard	Description
IEC: 60076	Specification of Power Transformers
IEC 61378 -1	Converter duty Transformers
IEC 60076-22-7	Fittings and Accessories for Power Transformers
IEC:60137	Specification of LV & HV Porcelain Bushing
IEC 60296	New Insulating oils
IEC 60076-22-1-2019	Buchholz Relay
IEC 60076-7	Specification for overloading of Transformers
EN 50588-1	Medium power transformers 50 Hz, with highest voltage for equipment not exceeding 36 kV - Part 1: General requirements





Standard	Description
IEC 61558-1	Safety of power transformers, power supplies, reactors and similar products - Part 1: General requirements and tests

*NFPA 850 for fire protection, nitrogen protection if required by the local guideline

General Construction:

- Each step-up transformer shall be 3 phase; 50 Hz: 11 kV at HV side, the noise level shall be in accordance to NEMA TR-1. Transformer shall have Off Circuit Tap Changer with tapings of at least -5% to +5% @ step of 1 is 2.5%. The vector group, impedance, bushing rating, HV/LV termination & neutral earthing shall also meet the system requirement & shall also be in line with standards as mentioned in this specification. Air clearance shall be in line with IEC 60076, Part-3. Transformer shall be in accordance to IEC: 60076. The transformer should be suitable for parallel operation.
- Max Losses for Inverter Duty Transformer should to be considered as follow, No Load loss – 0.1 % & Load Losses 1 %.
- Nitrogen Injection Fire Protection System (NIFPS) must to be provide if Oil Tank capacity is more than 2000 Litre.
- Before painting, all un-galvanized parts shall be cleaned made free from rust, scale and grease and external rough surfaces smoothened filled with metal deposition. The interior of the tank and other oil filled chambers shall be cleaned by shot blasting or any other suitable method. All external surfaces shall be given three coats of paints except for nuts, bolts and washers which may be given one coat after erection. The final coat shall be a glossy oil and weather proof, non-fading paints. The interior of mechanism chambers and kiosks shall be given 3 coats of paint, the final coat being of a light colored anti condensation mixture. Suitable glands plate to be provided at cable entry.
- Use of multi winding (Inverter manufacturer's recommendation) transformers is allowed. However, it should be taken care that for each two winding on LV side and there should be one winding on MV side. The multi-winding transformer needs to be designed for long term operating conditions with asymmetrical load on LV side i.e., for three winding design, the transformer needs to operate reliable with only one inverter supplying power to only one LV winding.
- For multi winding transformer, it is recommended to have close coupling and equal impedances on each of LV winding to HV winding and to have high enough impedance (as per inverter OEM recommendation) between two LV windings in order to decouple these windings.
- The transformer shall be capable of withstanding the short circuit stresses 40 kA due to a terminal fault on one HV winding with full voltage maintained on the other winding for minimum period of two (2) seconds.
- Transformer shall be constructed in accordance to IEC: 60076 or any other international standard. Transformer shall be complete & functional in all respect and shall be in scope of supplier.
- The other important construction particulars shall be as below.
- The Transformer tank and cover shall be fabricated from high grade low carbon plate steel of tested quality. The tank and the cover shall be of welded construction and there should be provision for lifting by crane.
- A double float type Buchholz relay conforming to relative IEC Standard shall be provided. The relay shall be provided with a test cock suitable for a flexible pipe connection for



checking its operation.

- Suitable Inspection hole(s) with welded flange(s) and bolted cover(s) shall be provided on the tank cover. The inspection hole(s) shall be of sufficient size to afford easy access to the lower ends of the bushings, terminals etc.
- All bolted connections to the tank shall be fitted with suitable oil tight gaskets which shall give satisfactory service under the operating conditions for complete life of the transformer if not opened for maintenance at site.
- The transformer shall be provided with conventional single compartment conservator. The top of the conservator shall be connected to the atmosphere through an indicating type cobalt free silica gel breather (In transparent enclosure). Silica gel is isolated from atmosphere by an oil seal.
- Transformer shall have adequate capacity Conservator tank to accommodate oil preservation system and volumetric expansion of total transformer oil. Transformer shall have Oil Temperature Indicator and Winding Temperature Indicator with an accuracy class of +/- 2deg C.
- The radiators shall be HDG, detachable type, mounted on the tank with shut off valve at each point of connection to the tank, along with drain valve at the bottom and relief valve at the top.
- The new insulating oil before pouring into the transformer shall conform to the requirement of IEC: 60296. No inhibitors shall be used in the oil.
- A sheet steel, weather, vermin and dust proof marshalling box shall be furnished with each transformer to accommodate temperature indicators & terminal boards for incoming and outgoing cables.
- Oil pit with sump pump arrangement to be provided if oil capacity of the transformer is more than 2000L. Capacity of oil pit shall be minimum 1.25 times of total oil capacity of transformer.
- Inverter Transformer shall have Copper Shield winding between LV & HV windings. Also each shield winding shall be taken out to tank with two separate connections from shield to bushing with proper support with shield bushings and same shall be brought down along with support insulator from tank & copper flat up to the bottom of the tank for independent grounding.
- In case of inverter transformer, it shall be proven and of successfully type tested design including short circuit test (as per IEC 60076 part 5).

Windings & Insulation

- The high and low voltage windings shall be of high-grade electrolytic copper free from scales & burrs. The winding insulation shall conform to appropriate voltage class as per relevant standard. The transformers shall be capable of withstanding the thermal and mechanical effects of a dead short circuit on any or all winding terminals with full voltage maintained on other winding as per IEC. The transformers shall sustain a symmetrical short circuit on secondary terminals for 1 second without damage or impairment. Each limb shall have two solid state winding temperature monitoring elements to initiate an alarm and trip for winding over temperature. However, the marshalling box, cable termination box, bus-duct termination chamber etc. shall have a degree of protection not less than IP 55. All structural members supporting the core assembly shall be hot-dip galvanized. All fasteners, bolts etc. shall be galvanized or zinc passivized.
- The supplier shall ensure that windings of all transformers are made in dust proof & conditioned atmosphere. Supplier shall furnish details of the facilities available at works



along with the techno-commercial offer. All windings of the transformers shall have uniform insulation. Tapping shall be so arranged as to preserve the magnetic balance of the transformer at all voltage ratio.

Core

The transformer shall have core type construction. The core shall be assembled out of low-loss, non-ageing; high permeability cold rolled grain oriented (CRGO) silicon steel laminations M4 grade or better steel of equivalent. The limb and yoke shall preferably be of the same cross-section having stepped design to give a circular shape. Each lamination shall be machined, treated, annealed and coated for insulation. The laminations shall be fitted, assembled and adequately tightened by bolting. The entire core assembly shall be covered with a resin-based lacquer for corrosion protection. Adequate Lifting lugs shall be provided for core and winding assemblies. Core isolation level shall be 2 kV (rms.) for 1 minute in air.

Tank And Conservator Of Oil Filled Transformer:

- The tank and cover of oil type transformer shall be fabricated from high grade low carbon plate steel of tested quality. The tank and the cover shall be of welded construction and there should be provision for lifting by crane. All bolted connections to the tank shall be fitted with suitable oil-tight gaskets which shall give satisfactory service under the operating conditions for complete life of the transformer if not opened for maintenance at site. Suitable Inspection hole(s) with welded flange(s) and bolted cover(s) shall be provided on the tank cover. The inspection hole(s) shall be of sufficient size and easy access to the lower ends of the bushings, terminals etc. A double float type Buchholz relay conforming to IEC shall be provided for oil type transformer. The relay shall be provided with a test cock suitable for a flexible pipe connection for checking its operation. The oil type transformer shall be provided with conventional single compartment conservator. The top of the conservator shall be connected to the atmosphere through a transparent type silica gel breather. Silica gel is isolated from atmosphere by an oil seal. The Transformer shall have adequate capacity Conservator tank to accommodate oil preservation system and volumetric expansion of total transformer oil. The conservator shall be bolted into position so that it can be removed for cleaning purposes.
- The oil type transformer shall have Oil Temperature Indicator and Winding Temperature Indicator with accuracy class of ± 2 deg. The radiators shall be detachable type, mounted on the tank with shut off valve at each point of connection to the tank, along with drain valve at the bottom and relief valve at the top. The new insulating oil before pouring into the transformer shall conform to the requirement of IEC-60296. No inhibitors shall be used in the oil. The oil samples taken from the transformer at site shall conform to the requirements of IEC. A sheet steel, weather, vermin and dust proof marshalling box (IP 55) shall be furnished.

Terminal And Marshalling Box

- Windings shall be brought out on suitable nickel-plated copper terminals with suitable arrangement shall be made for cable box connection at LV terminals as per design requirement, and unless otherwise specified. MV side will have a cable box/bushing arrangement as per the design proposed by the contractor subject to its approval by the owner.
- Nonmagnetic gland plate shall be provided for single core cables. Terminal chamber for Cable termination shall have a gasket cover plate, bolted to it. Separate inspection covers shall be provided to facilitate connection and inspection.
- All protection, alarm and indication devices shall be wired by means of PVC insulated



cables up to the marshalling box. The marshalling box shall be fabricated out of minimum 3 mm thick cold rolled sheet steel. There shall be two gland plates, one for internal wiring to the marshalling box from various devices which shall be glanded and pre-wired, while the second gland plate shall be removable and undrilled for glanding outgoing cables.

Cooling

- The transformers shall be preferably natural air-cooled. Oil filled transformers are cooled by means of coolers made of oval tubes or flat radiators by natural oil and air circulation (ONAN).

Tapping's And Controls

- On MV flange mounted off circuit tap changer links shall be provided and shall have -5% to +5% @ step of 2.5%. Under conditions of external short circuit as the winding, OCTC (Off Circuit Tap Changer) should have 2.5 times capacity of line current.

Fire Safety

This shall be as per Oman Electricity Code and as per relative IEC Standard, transformer shall be provided with requisite fire-fighting system. Sufficient no of fire extinguishers and sand buckets to be placed in transformers yard. Nitrogen injected firefighting systems shall be provided for transformers in which oil tanks capacity is more than 2000 Litre. Transformer protections should be in line with local or client's regulations.

Inverter Compliance

- Contractor has to confirm the compliance of its inverter transformer specifications with Inverter Manufacturer design guidelines, and the same has to be vetted with Inverter Manufacturer. Each LV winding must be capable of handling non-sinusoidal voltage with voltage gradient as per relevant applicable standards and Inverter manufacturer recommendation.
- Harmonic Factor as per Inverter manufacturer recommendation must be taken into account while designing the transformer. The extra no load loss due to voltage harmonics and load and stray load loss due to current harmonics (as applicable) and must be taken into consideration in transformer design. In addition, the dc bias component of 0.5% of rated inverter output current is to be accounted for its effect on the transformer design.

Fittings

The following fittings shall be provided with oil filled transformer:

- Oil conservator complete with plain and dial type oil gauges, filling hole with cap and drain plug
- Breather for conservators shall be mounted not more than 1400 mm above rail top.
- Minimum two Nos. of spring operated pressure relief devices with alarm / trip contacts. Discharge of PRD shall be properly taken through pipes & directed away from the transformer /other equipment.
- Air release plug.
- Inspection openings and covers.
- Bushing with metal parts and gaskets to suit the termination arrangement.
- Cover lifting eyes, transformer lifting lugs, jacking pads, towing holes and core and winding lifting lugs.
- Protected type Mercury or alcohol in glass thermometer.

Bottom and top filter valves with threaded male adapters, bottom Sampling valve & drain valve. Drain valves/plugs shall be provided in order that each section of pipe work can



be drained independently. Sludge valves at bottom most point of tank to be provided for easy flush out/removal of sludge during maintenance.

- Rating and diagram plates on transformers and auxiliary apparatus.
- 150 mm dial type oil temp indicator with alarm and trip contacts, maximum reading pointer & resetting device.
- 150-mm dial type Winding temp indicator for all windings with alarm and trip contacts, maximum reading pointer & resetting device.
- CCU (current converter units) for WTI & OTI with 4-20 mA signal for SCADA
- Flanged bi-directional wheels (as applicable).
- Marshalling Box.
- Rating and terminal marking plate.
- Lifting hooks and jacking pads, towing holes.
- Earthing terminals.
- Valves schedule plates.
- Double float type Buchholz relay with Alarm and Trip contacts, also with test cock suitable for flexible pipe connection for checking its operation with 2 Nos. Shut-off valves.
- Radiator bank complete with air release plug, drain plug and isolating valves at points of connection with tank.
- HV bushings with terminals.
- Sampling valve.
- 10% extra oil in non-returnable drums.
- Additional Bushing for grounding harmonic shield outside tank.
- HV or LV NCT (If applicable)
- 1 liter touch up paint
- NIFPS fitting as per guidelines
- Rain hood for Buchholz relay, PRV & MOG
- Oil level indicator.
- HV cable box with disconnecting chamber, extended CU busbar for cable termination, Danger plate, supporting channel (if required)
- Individual cable box for each LV winding with disconnecting chamber, extended tinned CU busbar for cable termination, Danger plate, supporting channel (if required)
- The fittings listed above are only indicative and other fittings, which generally are required for satisfactory operation of the transformer, are deemed to be included.

Performance

- The transformer & all its accessories including CT's etc., shall be designed to withstand without injury the thermal & mechanical effects of any external short circuit to earth & of short circuits at the terminal of any winding for a period of 2 sec.
- The transformers shall be capable of being operated continuously without danger at the rated MVA with voltage variation of +10% to -10%.
- The transformers shall be capable of being loaded in accordance with IEC: 60354 up to load of 150%. There shall be no limitation imposed by bushings etc. or any other associated equipment. Vendor has to provide transformer loading curve with respect to inverter output power at different temperature. The thermal design of Inverter Transformer needs to consider the temperature dependent performance of the inverter. It is in accordance with Inverter output and under worst condition it should not limit



inverter output.

- The transformers shall be capable of being operated continuously 110% without danger at the rated MVA capacity at 50°C ambient temperature.
- Although the products will be warranted for 5 years and power performance will be committed for 25 years, the lifetime of transformers is expected to be 25 years from commissioning. The adverse effect on life of transformer due to cloud intermittency and solar generation loading cycle must be compensated through suitable design (as applicable).
- Transformers shall withstand, without injurious heating, combined voltage & frequency fluctuations.

Submission

Following Supporting Calculations Has To Be Shared By Vendor:

- Transformer Overloading calculation
- Transformer life cycle calculation (Transformer life shall be 25 years minimum)
- Thermal ability of the transformers to withstand short-circuit as per IEC 60076
- Cooling area calculation
- Calculation for core area & flux density
- Fault level calculation from LV side & HV side
- Calculation of Inrush current
- Calculation of No load current at rated voltage & frequency
- PRV calculation
- NOTE:
- Dissolved gas analysis test shall be carried-out before and after heat run test.
- The supplier should clearly indicate the testing facilities available with them and tests which are to be arranged outside. Supplier shall submit in house test certificates at least 15 days in advance for final testing of T/F. For testing T/F, all measuring instruments shall be of highest efficiency and best quality.
- Project Specific Additional Requirements (if any) other than technical specifications specified above.
- The maximum temperature rise in oil and winding shall not be above 50°C and 55°C respectively considering an ambient temperature of 50°C.
- Transducers for providing 4-20mA signals for OTI & WTI for monitoring system Interface shall be provided.
- Relevant drawings, data and O&M instruction manuals shall be furnished, including drawings that are required to be approved by Owner / Consultant.

Make - As per Annexure-A

Routine Test & Factory Acceptance Test - As per Annexure- B

11 kV Switchgear Panel

All the switchboards shall be compliant to most recent standards (and latest amendments if any) developed by the IEC, OES and EN. Regulations applicable in the area where equipment is to be installed shall be followed.

Table below indicates a non-exhaustive list of standards to which the 11 kV switchgear should conform.

Table: Applicable Standards For MV Switchgear

Standard	Description
IEC 61869	Current Transformers



IEC 61869	Potential Transformers
IEC 62271	Metal enclosed switchgear and control gear for voltage up to 11 kV
IEC 61439	General requirements for switchgear and control gear for voltages exceeding 1000V
IEC 62271-1	High-Voltage Switchgear and Control gear, Part 1: Common Specifications
IEC 62271-102	High-Voltage Switchgear and Control gear, Part 102: Alternating Current Disconnectors and Earthing Switches
IEC 62271-200	High-Voltage Switchgear and Control gear, Part 200: AC Metal-Enclosed Switchgear and Control gear for Rated Voltages Above 1 kV and Up to and Including 52 kV
IEC 62271-202	High-voltage switchgear and control gear - Part 202: High-voltage/low-voltage prefabricated substation
IEC 60060	High Voltage Test Technique
IEC 60255-1	Measuring relays and protection equipment - Common requirements
IEC 60051	Phosphate treatment of iron and steel for protection against corrosion
IEC 62271	Dimensions of terminals of high voltage switchgear and control gear
IEC 60282	High voltage fuses
IEC 60099	Lightning Arresters for Alternating Current Systems - Metal Oxide Lightning Arresters Without Gaps
IEC 62052-11	Electricity metering equipment (A.C.) - General requirements, tests and test conditions - Part 11: Metering equipment
IEC 62053	Electricity metering equipment (A.C.) - Particular requirements
IEC 60694	Common specifications for HV switchgear & control gear standards
IEC 60529	Degree of protection provided by enclosures (IP)
IEC 61869-2	Current Transformer Tests
IEC 60137	Bushings for Alternating Voltages above 1 kV

General Requirements:

MV/HV switchgear shall meet the following general requirements and shall be suitable to withstand the fault level of 25 kA for 3 seconds or calculated Fault level using short circuit analysis & stability studies whichever is higher. LBS shall not be allowed. VCBs, CTs, Busbar, and other components as applicable shall be designed for fault level of 25 kA or as per short circuit analysis report, whichever is higher for 3sec. The Switchgear shall have an Internal Arc Classification of IAC FLR 25 kA for 1sec or in line with fault level of Switchgear Panel. The contractor shall submit ETAP based short circuit analysis calculation for approval.

Digital protection relays shall be provided for:

- MV power cables over 1000m length (differential protection)
- MV switchgear busbar (reverse interlocking protection)
- MV switchgear infeed, coupler and outgoing feeder protection
- Transformer protection

The switchgear construction shall be such that the operating personnel are not endangered by breaker operation and internal explosions, and the front of the panels shall be specially designed to withstand these. Pressure relief device shall be provided in each high voltage compartment of a panel, so that in case of a fault in a compartment, the gases produced are safely vented out, thereby minimizing the possibility of it's spreading to other compartments and



panels.

The switchgear boards shall have a single front, single tier, fully compartmentalized, metal enclosed construction complying with clause No. 3.102 of IEC 62271-200, comprising of a row of free-standing floor mounted panels. Each circuit shall have a separate vertical panel with distinct compartments for circuit breaker truck, cable termination, main busbars and auxiliary control devices. The adjacent panels shall be completely separated by steel/ Aluzinc sheets except in bus bar compartments where insulated barriers shall be provided to segregate adjacent panels. The Service Class Continuity of Switchgears shall be LSC 2B-PM (as per IEC 62271-200). However, manufacturer's standard switchgear designs without inter panel barriers in busbar compartment may also be considered.

The circuit breakers and bus VTs shall be mounted on withdrawable trucks which shall roll out horizontally from service position to isolated position. For complete withdrawal from the panel, the truck shall roll out on the floor or shall roll out on telescopic rails. In case a later arrangement is offered, a suitable trolley shall be provided by the Contractor for withdrawal and insertion of the truck from and into the panel. Testing of the breaker shall be possible in an isolated position by keeping the control plug connected.

The trucks shall have distinct SERVICE and ISOLATED positions. It shall be possible to close the breaker compartment door in isolated position also, so that the switchgear retains its specified degree of protection. Circuit Breaker rack-in and rack-out from Service to Test, Test to Isolated position, or vice-versa shall be possible only in the compartment door closed condition. While switchboard designs with doors for breaker compartments would be preferred, standard designs of reputed switchgear manufacturers where the truck front serves as the compartment cover may also be considered provided the breaker compartment is completely sealed from all other compartments and retains the IP 42 in case of indoor switchgear and IP 65 in case of outdoor switchgear in the isolated position.

The switchgear assembly shall be dust, moisture, rodent and vermin proof, with the truck in any position SERVICE, ISOLATED or removed, and all doors and covers closed. All doors, removable covers and glass windows shall have gaskets all round with synthetic rubber or neoprene or EPDM gaskets.

The control / relay compartments shall have degree of protection not less than IP 5X in accordance with IEC 60947. However, remaining compartments can have a degree of protection of IP 4X. All louvers, if provided, shall have very fine brass or GI mesh screen. Tight fitting gaskets are to be provided at all openings in relay compartment. Numerical Relays shall be fully flush mounted on the switchgear panels at a suitable height.

Enclosure shall be constructed with rolled steel / Aluzinc sections. The doors and covers shall be constructed from cold rolled steel sheets of 2.0 mm or higher thickness. Gland plates shall be 2.5 mm thick made out of hot rolled or cold rolled steel sheets and for non-magnetic material it shall be 3.0 mm. wherever required, stiffeners shall be provided to increase stiffness of large size doors and covers. Vertical panels shall be assembled to form a continuous line-up of uniform height. Rear extension panels shall also be of full height. The switchgear shall be cooled by natural air flow. Total height of the switchgear panels shall not exceed 2600mm. The height of switches, pushbuttons and other hand operated devices shall not exceed 1800mm and shall not be less than 700mm.

Switchgear construction shall have a bushing or other sealing arrangement between the circuit breaker compartment and the busbar/ cable compartments, so that there is no air communication around the isolating contacts in the shutter area with the truck in service position.

The breaker and the auxiliary compartments provided on the front side shall have strong hinged



doors. Busbar and cabling compartments provided on the rear side shall have separate bolted covers with self-retaining bolts for easy maintenance and safety. Breaker compartment doors shall be provided with single-shot latch type handle and shall have locking facility. A suitable interlock shall be provided, which will ensure that breaker is OFF before opening the back doors. Suitable interlock shall be provided to prevent opening of any compartment doors which has any of the MV equipment, in case the supply is ON.

In the Service position, the truck shall be so secured that it is not displaced by short circuit forces. Busbars, jumpers and other components of the switchgear shall also be properly supported to withstand all possible short circuit forces corresponding to the short circuit rating specified.

Suitable base frames made out of steel channels shall be supplied along with necessary anchor bolts and other hardware, for mounting of the switchgear panels. These shall be dispatched in advance so that they may be installed and leveled when the flooring is being done, welding of base frame to the insert plates as per approved installation drawings shall be in Contractor's scope.

Independent pressure relief devices shall be provided for HV compartment, i.e. bus bar, cable and breaker compartment and each compartments shall be tested for internal arc fault. Pressure relief flap shall be equipped with limit switches which shall be wired to the Main O/G VCB & Bus coupler.

All identical equipment and corresponding parts shall be fully interchangeable.

It shall be possible to extend the switchgear in either direction at a later date. Ends of bus bars shall be suitably drilled for this purpose. Panels at extreme ends shall have openings, which shall be covered with plates screwed to the panel.

All relays, metering, and control components shall be mounted on the panel front only. All terminals shall be shrouded with plastic covers to prevent accidental contact.

Bi-directional MFM meter (0.5 class) shall be provided with RS485 communication in all incomer and outgoing feeders including inverter room MV Panel. TTB shall be provide with meter.

MV/HV switchgear shall be VCB (for inverter transformer & aux transformer) of suitable ratings. The switchboard shall comprise of 3-phase Copper bus bar which shall extend through all units of the switchgear line-up. The main bus bars shall have uniform cross-section throughout their length, and shall be sized to carry continuously the current. Bus bars shall be housed in a separate chamber and shall be accessible for inspection wire guards or mesh shall be provided inside the enclosure to allow visual inspection of bus bars, to avoid accidental contact when the cover is removed.

Bus bars shall be of high conductivity electrolytic copper and shall be insulated by using heat-shrinkable PVC sleeves. PVC shrouds shall be provided on the taps or joints.

Bus bars shall be supported at regular intervals on epoxy resin Insulators made of non-hygroscopic, non-inflammable material with tracking index equal to or more than that defined in IEC Standard. Both bus bars and the supports shall be adequately sized and braced to withstand the specified short-circuit current for 1 second.

Bus bars shall be prominently marked with Red, Yellow and Blue colour rings for easy phase identification at regular interval and at every power tap off point.

The main bus bars and connections shall be rated for the specified continuous current, inside the panel without deration or application of any diversity factor. Clearance between phases and phase-earth will be as IEC-56. The switchgear shall withstand impulse test voltages. The minimum earth bus bar size shall be suitable for short circuit withstand capacity of 25 kA for 3 sec.

The incoming power from various zones shall be through XLPE cables and outgoing power



connection shall also be through XLPE cables. The Ample space for connection of these cables shall be provided at the rear of the switchboards. In order to avoid accidental contact in the cable compartment while carrying out inspection by opening the rear cover, a removable expanded metal barrier shall be provided in the cable compartment. Unless otherwise specified, the power cable shall enter the switchboard from the bottom.

The rear covers shall be provided with rear door interlock mechanism that will break the power when the door is opened under live busbar conditions.

The panels shall be provided with space heaters including thermostat to prevent moisture condensation.

The switchboard will be complete with provision for inter panel wiring and ready for installation at site where external power and control cables shall only be connected. The switchboard shall be Powder Coated & finished. The switchboard shall comprise of the equipment / components listed below in BOM.

All routine & acceptance tests shall be carried out at manufacturer's work in presence of project in charge, Consultant or Owner representative.

All Relays should be numerical type (Integral relays along with RS 485 / MODBUS RTO). All relays and switchgears status has to be communicated to common PLC SCADA to monitor and control the system.

Annunciator window shall be provide for require fault indication and alarm. Separate indication lamp (LED type) shall be provide for VCB status, Fault and position indication.

2 Hour Back up DC Power Pack, to be provide as per the total load requirement.

Auxiliary Wiring And Terminals

Inside the cubicles, the wiring for control, signaling, protection and instrument circuits shall be done with, PVC insulated, flame retardant type, and copper conductor wire. The insulation grade shall be 1100 V. The wiring shall preferably be enclosed in plastic channels or neatly bunched together, wiring between MV breakers or cable compartment to relay and metering compartments shall be routed through flexible conduits.

Each wire shall be identified at both ends by correctly sized PVC ferrules, shorting links shall be provided for all CT terminals.

CT secondary wiring shall be done with 2.5 mm² copper conductors. Other control wiring may be with 1.5 mm² copper conductors.

Control Supply And Space Heater Supply

One suitable rated 230V single-phase AC supply feeder per switchboard. Contractor shall provide suitable Arrangement of 230 / 110V Supply. Contractor shall provide necessary switch and fuse to receive, isolate and distribute to each panel.

Each sub circuit shall have separate MCB. MCB size shall be determined so as to achieve selective clearance between main circuit and sub circuit in case of fault. Potential circuits for protection and metering shall also be protected by separate MCB.

All fuses shall be of HRC link type conforming to IEC Standard. Fuses shall have operation indicators for indicating blown fuse condition. Fuse carrier base shall have imprints of the fuse rating and voltage. All accessible live connection to fuse bases shall be adequately shrouded.

All DC circuits shall be MCB on both poles. Single phase AC circuits shall have fuses on line and link on neutral.

DC and AC supply monitoring relay shall be provided and alarm shall be generated in SCADA system in case of failure of supply.

Surge Arrestor

The surge arrestors shall be provided as per system requirement and shall be of metal oxide, gapless type generally in accordance with IEC 60099-4 and suitable for indoor duty.



Surge arrestor selected shall be suitable for un-earthed system and rating shall be in such a way that the value of steep fronted switching over voltage generated at the switchgear terminals shall be limited to the requirements of switchgear.

The surge arrestors shall be mounted within the switchgear cubicle between line and earth, preferably in the cable compartment.

Circuit Breaker

3 pole fully draw out Vacuum Circuit Breaker breakers (Trolley mounted) conforming to IEC-56 (as modified till date) with trip free & anti pumping feature & with distinct Test, Service & Isolated positions. Mechanical Trip lever & PB, Breaker operation counter (Mechanical), limit switches for Service & Test positions; Individual mechanical indicators for breaker ON / OFF / spring charged / spring discharged conditions.

The CB shall have the Closing mechanism consisting of motor charged stored energy closing spring, operated by a Closing Coil release. Spring charge motor shall be fed by UPS supply only.

An opening mechanism consisting of motor charged stored energy opening spring, operated by Tripping Coil releases (two nos.). One trip coil shall be operate on DC supply & other trip coil shall be operate on AC supply (fed from UPS).

The spring charging mechanisms shall be provided with a standby manual spring charging mechanism & handle.

1 NO +1 NC contacts of the Test & Service position limit switches shall be directly wired up to the terminal block for use outside the switchboard. 1NO+1NC contacts of the CB auxiliary contacts shall be directly wired up to the terminal block for use outside the switchboard. 6NO+6NC contacts of the CB auxiliary switch shall be, either directly or through multiplying contactors (separate for NC & NO contacts), wired to the terminal block for use outside the switchboard.

These contacts shall operate only in the service position of the breaker.

Electrical & Mechanical interlocks shall be provided as specified by Owner in the control scheme in addition to safety interlocks. However, no electrical or Mechanical interlocks (except safety) in the test position of the CB.

Breaker transport trolleys required for cassette-mounted breakers shall be provided.

Circuit breakers shall be equipped with manual spring charge facility for closing the breaker as an alternative to motorized operation. Anti-pumping to be consider for all breakers with provision of additional Anti –pumping contactor.

The time taken for charging of closing spring shall not exceed 30 seconds. The spring charging shall take place automatically preferably after a closing operation. One open- close- open operation of the circuit breaker shall be possible after failure of power supply to the motor. Spring charging motors shall be capable of starting and charging the closing spring twice in quick succession without exceeding acceptable winding temperature when the control supply voltage is anywhere between 187V-242V DC. The motor shall be provided with short circuit protection.

Numerical Relays And Networking

All circuit breaker feeders shall be provided with communicable numerical relays (IED, i.e. Intelligent Electronic Device), having protection, control, measurement and monitoring features. These relays shall be networked and suitably interfaced with the Solar SCADA system for dynamic SLD display, status monitoring, measurements, event / alarm displays, reports, etc. The relays shall be flush mounted on panel front with connections from the inside. These numerical relays shall be of types as proven for the application and shall be subject to approval.

Numerical relays shall have appropriate setting ranges, accuracy, resetting ratio and other characteristics to provide required sensitivity. All equipment shall have necessary protections.



The numerical relay shall be capable of measuring and storing values of a wide range of quantities, events, faults and disturbance recordings. The alarm / status of each of protection function and trip operation shall be communicated to Solar SCADA. The numerical relays shall have built in feature / hardware interface to provide such inputs to Solar SCADA / for analog / digital values.

All relays shall be rated for control supply voltage as mentioned elsewhere under parameters and shall be capable of satisfactory continuous operation between 80-120% of the rated voltage. Making, carrying and breaking current ratings of their contacts shall be adequate for the circuits in which they are used. Contacts for breaker close and trip commands shall be so rated as to be used directly used in the closing and tripping circuits of breaker without the need of any interposing / master trip relays. Threshold voltage for binary inputs shall be suitably selected to ensure avoidance of mal operation due to stray voltages and typically shall be more than 70% of the rated control supply voltage.

Failure of a control supply and de-energization of a relay shall not initiate any circuit breaker operation.

Disturbance Record waveforms, event records & alarms shall be stored in Non-volatile memory and failure of control supply shall not result in deletion of any of these data.

All numerical relays shall have freely programmable optically isolated binary inputs (BI) and potential free binary output (BO) contacts as per the requirement of control schematics. The quantities of such input / outputs shall be finalized during detailed engineering.

All the numerical relays shall have communications on two ports, local front port communication to laptop and rear port on IEC 61850 / RS 485 to communicate with the interface equipment for connectivity with the Solar SCADA. Laptop provided with SCADA (or other equipment) shall be used to facilitate numerical relay configuration, and event/fault records downloading from relay locally. Latest version of hardware and Software for interfacing the numerical relays with laptop shall be provided. SCADA Laptop detailed configuration must ensure suitability for the required applications. At least two sets of communication cable for Laptop to relay communication shall be provided.

All the numerical relays shall have adequate processor memory for implementing the programmable scheme logic required for the realization of the protection / control schemes, in addition to the built in protection algorithms. Numerical relays shall have inrush detection feature for blocking of user selectable protection functions.

All Numerical relays shall have features for electrical measurements including voltage, current, power (active & reactive), frequency, and power-factor and energy parameters. Shall be able to provide the same in soft to solar SCADA system.

Relays shall have event recording feature, recording of abnormalities and operating parameters with time stamping.

All numerical relays shall have provision of both current and voltage inputs. Relays shall be suitable for both residually connected CT input as well as CBCT input. Number of CT inputs shall be adequate for protections detailed elsewhere but not less than 4 sets, 3 nos. for phase fault & 1 no. for earth fault. Relays shall be suitable for CT secondary current of 1A. All other feeders' relays shall have provision for 3 VT inputs. Relays used in outgoing, bus couplers shall have provision of two sets of voltage signal inputs for the purpose of synchronization. Actual requirement shall be finalized during detail engineering stage.

All CT & VT terminals on the relays shall be of fixed type suitable for connection of ring-type lugs to avoid any hazard due to lose connection leading to CT open-circuit. In no circumstances Plug-in type connectors shall be used for CT / VT connections.

All numerical relays shall have key pad / keys to allow relay settings from relay front. All hand



reset relays shall have reset button on the relay front. Relay to be self or hand reset shall be software selectable. Manual resetting shall be possible from remote.

Relays shall have self-diagnostic feature with self-check for power failure, programmable routines, memory and main CPU failures and a separate output contact for indication of any failure.

Relays shall have at least two sets or groups of two different sets of adaptable settings. Relays shall have multiple IEC programmable characteristics.

Design of the relay must be immune to any kind of electromagnetic interference. Vendor shall submit all related type test reports for the offered model along with the offer.

All cards / hardware of numerical relays shall be suitable for operation in Harsh Environmental conditions with respect to high temperature, humidity & dust.

Relay shall be immune to capacitance effect due to long length of connected control cables. Any external hardware, if required for avoiding mal operation of the relay due to cable capacitance shall be included as a standard feature.

All I/Os shall have galvanic isolation. Analog inputs shall be protected against switching surges, harmonics etc.

Numerical relays shall have two level password protections, one for read only and other for authorization for modifying the setting etc.

Numerical relays shall have feature for Time synchronization through the SCADA System / networking. The resolution of time synchronization shall be +/- 1.0 millisecond or better throughout the entire system.

Relays & Ethernet switches shall be suitable to accept both AC & DC supplies with range of 70 % to 120 % of rated voltage.

Disturbance Record waveforms, event records & alarms shall be stored in Non-volatile memory and failure of control supply shall not result in deletion of any of these data.

Contractor to depute protection engineer for finalization of relay setting and configuration during detail engineering stage. All numerical protection relay configuration and setting shall be done as per approved setting and configuration at switchgear manufacturer work or site by protection engineer. All numerical relay testing and logic/interlock checking during commissioning stage at site shall be done under the supervision of switchgear OEM or his authorized representative.

The numerical relay shall have the following protection functions with at least two independent protection setting groups. The protection functions shall be selectable from any of the IEC characteristic curves. Numerical relay shall be provide with RTB arrangement.

- i. Definite time (DT) phase over current protection
- ii. Inverse Definite Minimum Time (IDMT) phase over current protection
- iii. Definite time (DT) earth fault current protection
- iv. Inverse Definite Minimum Time (IDMT) earth fault current protection
- v. Under Voltage protection
- vi. Over Voltage protection

The numerical relay shall have trip circuit supervision facility to monitor the circuit breaker trip circuit both in pre-trip and post-trip conditions. The relay shall also be able to provide circuit breaker monitoring, CT and VT supervision.

Transformer feeder protection relay shall have provision for the following protection functions.

- Buchholz alarm & trip
- Oil Temperature Indicator (OTI) alarm & trip
- Winding Temperature Indicator (WTI) alarm & trip
- Pressure Relief Valve (PRV) trip



- Magnetic Oil Gauge (MOG) alarm

Other Protections And Control Functions In The Relays

Trip circuit supervision shall be provided for all feeders to monitor the circuit breaker trip circuit both in pre-trip and post trip conditions.

Schematics requiring auxiliary relays / timers for protection function shall be a part of numerical relay. The number of auxiliary relay and timer function for protection function shall be as required. Timer functions shall be programmable for on/off delays.

The numerical relay shall be able to provide supervisory functions such as trip circuit monitoring, circuit breaker state monitoring, PT and CT supervisions and recording facilities with Post fault analysis.

The numerical processor shall be capable of measuring and storing values of a wide range of quantities, all events, faults and disturbance recordings with a time stamping using the internal real time clock. Battery backup for real time clock in the event of power supply failure shall be provided.

At least 200 time tagged events / records shall be stored with time stamping. Details of at least 5 previous faults including the type of protection operated, operating time, all currents & voltages and time of fault.

Diagnostics Automatic testing, power on diagnostics with continuous monitoring to ensure high degree of reliability shall be provided. The results of the self-reset functions shall be stored in battery back memory. Test features such as examination of input quantities, status of digital inputs and relay outputs shall be available on the user interface.

The alarm/status of each individual protection function and trip operation shall be communicated to solar SCADA.

Sequence of events shall have 1 ms resolution at device level.

Measurement accuracy shall be 1 % for RMS Current and voltage.

Instrument Transformers

All current and voltage transformers shall be completely encapsulated cast resin insulated type, suitable for continuous operation at the ambient temperature prevailing inside the switchgear enclosure, when the switchboard is operating at its rated load and the outside ambient temperature is 50 deg. C. The class of insulation shall be E or better.

All instrument transformers shall withstand the power frequency and impulse test voltage specified for the switchgear assembly. The current transformer shall further have the dynamic and short time ratings at least equal to those specified for the associated switchgear and shall safely withstand the thermal and mechanical stress produced by maximum fault currents specified when mounted inside the switchgear for circuit breaker modules.

All instrument transformers shall have clear indelible polarity markings. All secondary terminals shall be wired to separate terminals on an accessible terminal block.

Current transformers may be multi or single core and shall be located in the cable termination compartment. All voltage transformers shall be draw-out type and single phase type. The bus VTs shall be housed in a separate panel on a truck (if applicable) so as to be fully withdrawable. In all switchgear panels line VTs in outgoing feeders shall be provided.

All voltage transformers shall have suitable HRC current limiting fuses on both primary and secondary sides. Primary fuses shall be mounted on the withdrawable portion. Replacement of the primary fuses shall be possible with VT truck in isolated position. The secondary fuses shall be mounted on the fixed portion and the fuse replacement shall be possible without drawing out the VT truck from service position.

Core balance CTs (CBCT) shall be provided in incoming feeders and outgoing feeders. These



CBCTs shall be mounted inside the switchgear panel. The window size of CBCT's shall be based on the overall diameter of the cables, to be finalized during detailed engineering. The CBCT shall be of circular window type. The ELR to be provided along with CBCT for fault detection.

Warranty:

The HT panel unit shall be warranted against all material/ manufacturing defects and workmanship for minimum of 5 (Five) years from the date of supply.

Testing & Inspection:

a) Type tests

The switchgear panel shall be of type tested design. The following type test reports shall be submitted during detailed engineering. The tests should have been conducted on the similar equipment by Oman Government approved accredited laboratory.

Test	Standard	Relevant Clause	IEC
Switchgear Panel			
Dielectric tests			
Power frequency voltage test	IEC 62271-200	6.2.6.1	
Lightning impulse voltage test	IEC 62271-200	6.2.6.2	
Dielectric tests on auxiliary and control circuits	IEC 62271-200	6.2.10	
Measurement of the resistance of the main circuit	IEC 62271-200	6.4.1	
Temperature-rise tests	IEC 62271-200	6.5	
Short-time withstand current and peak withstand current tests	IEC 62271-200	6.6	
Verification of the IP coding	IEC 62271-200	6.7.1	
Verification of making and breaking capacities	IEC 62271-200	6.101	
Mechanical operation test	IEC 62271-200	6.102	
Internal arc test	IEC 62271-200	6.106	
Circuit Breaker			
Mechanical operation test at ambient air temperature (M2 Class)	IEC 62271-100	6.101.2	
Basic short-circuit test-duties	IEC 62271-100	6.106	
Relays			
Vibration tests	IEC 60255-21-1		
Shock and bump tests	IEC 60255-21-2		
Seismic tests	IEC 60255-21-3		
Electromagnetic compatibility requirements	IEC 60255-26		
Product safety requirements	IEC 60255-27		
Common requirements	IEC 60255-1		
Communication requirements	IEC 61850		
Current Transformers			



Test	Standard	Relevant Clause	IEC
Temperature-rise test	IEC 61869-2	7.2.2	
Impulse voltage withstand test on primary terminals	IEC 61869-2	7.2.3	
Tests for accuracy	IEC 61869-2	7.2.6	
Short-time current tests	IEC 61869-2	7.2.201	

b) Routine tests

Routine tests and acceptance tests shall be as per the Quality Assurance Plan (QAP) approved by the Employer.

Submission:

Following are the documents that shall be submitted by the Contractor:

- Quality assurance plan (QAP)
- Schematic diagram of the MV/HT panel.
- Different calculation to support design.
- Catalogues of spares recommended with drawing indicating each items of spares.
- List of spares and special tools recommended by the supplier.
- Copies of Type Test Certificates as per latest IEC/BIS.
- Drawings of equipment, relays, control wiring circuit, etc.
- Foundation plan drawing, stability analysis & Design Basis Report /Calculation
- Technical literature giving complete information of the components / equipment.
- Erection, Operation and Maintenance Manual complete with all relevant information, drawings and literature for auxiliary equipment and accessories, characteristics curves for relays etc.

Makes - As per Annexure- A

Routine Test & Factory Acceptance Test - As per Annexure- B

Earthing System

The entire PV plant area including Inverter control station or Inverter rooms and HV switchgear shall be appropriately earthed with adequate number of earth pits. Earthing system shall comply with the latest edition of relevant international standards describing code of practice of earthing and IEEE80. The earthing system shall have complete earthing network comprising of wires, copper tapes, electrodes and earth bonding of all relevant necessary non-current carrying metal parts of equipment's/ apparatus shall be connected as required.

The earthing system includes earth electrodes, earth flats, wires, earthing cables installation of earth electrode in suitable pit size, construction of earth pit with cover for the installation, connection of earth electrode with equipotential earth bus and connection of equipment to equipotential earth bus.

Codes And Standards

Standard	Description
IEEE: 80	IEEE guide for safety in AC substation grounding
IEEE: 837	Standard for qualifying permanent connections used in substation grounding
IEEE 142	Practice for Grounding of Industrial and Commercial Power Systems
OES	Applicable Standards as per APSR Guidelines
IEC 60364-5-54	Low-voltage electrical installations - Part 5-54: Selection and erection



	of electrical equipment - Earthing arrangements and protective conductors
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Specific Design Requirements

- Earthing network within the PV plant array yard will be of CU Earthing Bare Conductor or as per local OES standards. All mounting structures, string Inverter shall be connected to earth grid with appropriate size of earth conductor. Sufficient earth pits shall be planned to maintain earth resistance (less than 1 ohm) ensuring hazard free operation of PV plant. Each equipment shall be earthed through an additional protective conductor with equipotential bonding conductor.
- Each MV transformer shall have a minimum of four dedicated earthing stations.
- Transformer body earthing will be with CU material. However, wherever shield winding of transformer is required to be earth strictly, copper strip / cable should be used. Dedicated earthing pits shall be provided for lightning protection system. If required positive or negative pole of the DC system shall be grounded at Inverter station.
- All the earth pits shall be appropriately connected to maintained overall resistance of plant below acceptable limits (less than 1 ohm).
- All the earthing pits shall be provided with test links of phosphorus bronze and located at 150 mm above ground level in an easily accessible position for testing.
- All the earth pits shall be kept at minimum 3 Meters away from the edge or civil foundation of any building/ equipment. Also the distance between nearby earth pits shall be minimum 3 Meters.
- To ensure the continuity of the earth conductor all the joints between risers from the equipment and main earth conductor shall be electric arc welded or mechanically jointed by Bolt and connection via suitable CU lugs where it is required.
- Protective conductors shall be suitably protected against mechanical and chemical deterioration. Joints of protective conductors shall be accessible for inspection and testing.
- Earth conductors shall be laid along with cable trays containing power cables should be placed at the top.
- Earthing conductor connections to equipment should be made onto vertical surfaces only. No connection point should be less than 150 mm above ground level. The earth grid should be run at a minimum depth of 60 cm below ground.
- If using artificial treatment, the possible corrosive effect of the salt on the driven rods and connections should be considered.
- All SCADA panel shall be provided with separate earthing network dedicated for instrument earthing complying with requirements of SCADA vendor. It should be separate from Plant electrical earthing or Lightning earthing grid.

Specific Construction Requirements

Earth Electrode

The earth electrode is in direct contact with the ground provides means for conducting earth current with ground. Earth Electrode material should have good electrical conductivity and mechanical strength and should not corrode in wide variety of soil conditions. For an effective earthing system, following type of earth electrodes can be used as below:

Copper Bonded Rods: High tensile-low carbon steel rod having diameter not less than 17.2 mm to be selected based on earth fault current. The Rod shall comply to with requirements of BS 4360 Grade 43A or EN10025-2-004 S275JR, molecularly bonded by 99.99% pure high conductivity copper on outer surface with copper coating thickness 250 micron or more in



conformity to UL-467, Length 3000 mm (minimum). Its surface shall be clean, free from mechanical defect and any visible oxide layer or foreign material.

Earthing Enhancement Compound

A low resistance earth electrode system is important to provide a low impedance path for the better dissipation of lightning/Fault currents, and to protect personnel and equipment by minimizing and equalizing voltage potential differences. Earthing (ground) enhancement materials shall be used to improve the ground electrode resistance. Earth enhancement material shall be a superior conductive material which improves earthing effectiveness, especially in areas of poor conductivity (rocky ground, areas of moisture variation, sandy soils etc.). It shall be tested and should conform to the requirements of IEC 62561-7. It shall have the following characteristics:

- High conductivity improves earth's absorbing power and humidity retention capability, non-corrosive in nature having low water solubility but highly hygroscopic.
- Carbon based with min 95% of fixed carbon content premixed with corrosion resistant cement to have set properties. Cement shall not mix separately & shall not have Bentonite.
- Resistivity of less than 0.2 ohms -meter.
- It shall not depend on the continuous presence of water to maintain its conductivity and shall be permanent & maintenance free and in its "set form", maintains constant earth resistance with time.
- It shall not dissolve, decompose or leach out with time and shall be environmentally friendly, suitable for soils of different resistivity and any kind of earth electrode.
- The Earth enhancement material shall be supplied in sealed, moisture proof bags, marked with Manufacturer's name or trade name, quantity etc. The minimum quantity of earth enhancement compound to be used with each earth pit shall be 50 Kg.

Bare Copper Earthing Conductor

- The bare copper conductors shall consist of concentric-lay stranded conductors made from uncoated annealed round soft drawn copper wires of class 2 non compacted as per IEC 60228. The bare copper conductor shall be constructed in conventional concentric-lay conductor type. The direction of lay of the outer layer shall be right hand and shall be reversed in successive layers. No joints of any kind shall be made in the finished copper wires. Joints may be made in the rods or semi-finished wires prior to drawing to final size, provided that the supplier can guarantee that the joint will have at least 90% of the tensile strength of the un-jointed rod. Welded joints in the copper wires shall be not closer than 15m to another or to either end of the wire. No more than two such joints shall be present in any reel length of the conductor.
- Technical Details for AC Earthing System
- This section covers equipment earthing for Transformer, HT and LT Switchgear Panel and other similar panel, Transformer neutral and Shield, Electronic earthing installed at Inverter room/Pooling Switchgear room.
- The Contractor shall furnish the detailed design and calculations for Employer's approval for equipment earthing. Contractor shall obtain all necessary statutory approvals for the system.
- Fault current for earthing design and calculation shall be as mentioned in relevant chapter.

The earth conductors shall be free from pitting, laminations, rust, scale and other electrical, mechanical defects.



- The material of the earthing conductors shall be as follows:
- Earthing terminals of Inverter shall be connected using Earthing CU cable as OEM recommended via hardware & accessories.
- In absence of clear guideline on earthing from Inverter OEM, minimum one earth pit per String Inverter shall be considered, earthing calculation for total no. of pits shall be submitted during detailed engineering for Approval. The sizes of earthing conductors for various electrical equipment shall be confirmed during detailed engineering as per approved earthing calculation.
- Metallic frame of all electrical equipment shall be earthed by two separate and distinct connections to earthing system. Steel columns, metallic stairs, and rails etc. of the building housing electrical equipment shall be connected to the nearby earthing grid conductor by one earthing ensured by bonding the different sections of hand rails and metallic stairs.
- Each continuous laid lengths of cable tray shall be earthed at minimum two places by CU Cables to earthing system, the distance between earthing points shall not exceed 30 meter. Wherever earth mat is not available, necessary connections shall be done by driving an earth electrode in the ground
- Neutral connections and metallic conduits/pipes shall not be used for the equipment earthing. Lightning protection system down conductors shall not be connected to other earthing conductors above the ground level.
- Earthing conductors buried in ground shall be laid minimum 600 mm below grade level unless otherwise indicated in the drawing. Back filling material to be placed over buried conductors shall be free from stones and harmful mixtures. Back filling shall be placed in layers of 150 mm.
- Earthing conductors embedded in the concrete floor of the building shall have approximately 50 mm concrete cover.
- Earthing conductor shall be buried at least 2000mm outside the fence of electrical installations. Every alternate post of the fences and all gates shall be connected to earthing grid by one lead.
- Where conductor crosses trenches, pipes, ducts, tunnels, rail tracks, etc., it shall be at least 300mm below them.
- Conductor joints shall be made by electric arc welding or any other method if approved during detail engineering, with resistance of joint not more than that of the conductor. In addition to Equipment earthing pit, 2 (two) nos. Isolated earth pit for each inverter transformer for shield earthing and 1 (one) no. Isolated earth pit for electronic earthing shall be provided. Connection between Transformer shield to earth pit shall be with 25X6 Cu flat (Min). Electronic earth pit shall be connected as per guideline of equipment manufacturer.

Testing

The earthing stations and the earthing network tested for following on completion of the installation:

- Earth resistance of electrodes
- Continuity of conductors, joints, etc.

Submission

The Contractor shall make following essential submissions:

- Site plan indicating earth pits, earthing strip routing, road cross overs, etc.
- Earthing calculations along with schematic drawing for the entire network



- Drawing showing the dimensions, materials and position of all components, earth electrodes, earth conductors, etc.

Lightning Protection System

The Solar PV Power plant should be provided with Lightning and overvoltage protection. The "Lightning Protection System" must be completed prior to start-up of commissioning activities of the project. The main aim of overvoltage protection is to reduce the overvoltage to a tolerable level before it reaches the PV or other sub - system components. The source of overvoltage can be lightning or other atmospheric disturbance.

The Lightning Conductors shall be made as per NFC Standards in order to protect the entire Array Yard from Lightning stroke. Necessary concrete foundation for holding the lightning conductor in position, to be made after giving due consideration to maximum wind speed and maintenance requirement at site in future.

Codes And Standard

The Lightning protection system & the components used shall conform to the latest edition of the following codes / Standards, relevant other International standards as applicable.

Standard	Description
NFC-17-102	For E.S.E. type Lightning arrester
BS EN:50164	Testing of all metallic part connected to lightning arrester IEC:62561
UNE 21186-96	For E.S.E. type Lightning arrester

Down Conductors

- Down conductors shall be as short and straight as practicable and shall follow a direct path to earth electrode.
- Each down conductor shall be provided with a test link at 1000 mm above ground level for testing but it shall be in accessible to interference. No connections other than the one direct to an earth electrode shall be made below a test point.
- Insulated Cooper conductor of minimum 70 Sqmm size shall be used as down conductor.
- Down conductors shall be cleated on outer side of building wall, at 750 mm interval or welded to outside building columns at 1000 mm interval.
- Lightning conductor on roof shall not be directly cleated on surface of roof. Supporting blocks of PCC/insulating compound shall be used for conductor fixing at an interval of 1000 mm.
- All metallic structures within a vicinity of two meters of the conductors shall be bonded to conductors of lightning protection system.
- Lightning conductors shall not pass through or run inside GI Conduits.
- Testing link shall be made of galvanized steel of size 25 x 6mm.
- Hazardous areas handling inflammable/explosive materials and associated storage areas shall be protected by a system of aerial earths.

Lightning Protection System for Solar Array

- Complete Solar Array with associated structure shall be protected from Direct Lightning Stroke. Lightning Protection for solar array shall be achieved with Early Streamer Emission (ESE) Air Terminal system.
- Suitable earthing and equipotential bonding shall be ensured for the air termination rods as per applicable standard/Equipment manufacturer guidelines.
- Current carrying parts and accessories such as clamps, fasteners, down conductor, Test



links and earth termination etc. shall be preferably procured from OEM of Air Terminals if it is supplied by them as part of lighting protection system.

- Location and layout of ESE terminal shall be in such a manner that it cast no shadow on the PV Modules during 08:30 AM to 04:30 PM or time chosen in shading analysis. Number and location of ESE air terminal shall be decided during detail engineering. For this purpose, design calculation and AutoCAD drawing of the layout of ESE terminal shall be submitted for approval.
- ESE air terminal shall be type tested in any national/international approved lab for advance triggering time (ΔT) and lighting Impulse current test and type test report shall be submitted for approval.
- Each ESE air terminal shall be provided with separate earthing termination and test link for equipotential bonding of lighting protection system as per OEM guidelines/NFC 17 - 102. Each ESE air terminal shall be equipped with lightning stroke counter to be fixed at suitable height in serial on the down conductor.
- ESE air terminal shall be erected on isolated foundation to be approved by Client. If required, Suitable guy wire shall be used to support the mast of ESE terminal against the wind.

Makes - As per Annexure- A

Routine Test & Factory Acceptance Test - As per Annexure- B

UPS

General Specifications:

The minimum capacity of the UPS at load factor of 0.8 lagging inclusive of 10% design margin at 50 deg C. The UPS shall have an overload capacity of 125% rated capacity for 10 minutes and 150 % rated capacity for 10 seconds. The overall efficiency of UPS shall be at least 90% on full load.

The UPS system shall be capable of operating without D.C. battery in circuit under all conditions of load and the performance of various components of UPS like inverter, charger, static switch etc. shall be guaranteed without the battery in circuit.

UPS shall be double conversion True On-line type. For UPS capacity 5 kVA or more, in addition to indications/display on UPS panel, important alarms along with important analog signal shall also be provided for use in SCADA. For UPS capacity less than 5 kVA contractor shall provide status, common alarm, and trip DI (soft or hard) signal to SCADA.

The battery charger / rectifier shall be self-regulating, solid-state silicon controlled, 3 phase, full-wave advance PFC rectifier with IGBT based charger type designed for single and parallel operation with battery and shall have automatic voltage regulators for close voltage stability even when AC supply voltage fluctuates. The charger should be capable to fully charge the required batteries as well as supply the full rated load through inverter. The charger shall be able to re-charge the fully discharge battery within 8 hours. The charger shall be design for input supply variation of $\pm 10\%$ and frequency variation of $\pm 5\%$. Charger design shall ensure that there is no component failure due to fluctuations of input supply or loss of supply and restoration. Regulation at nominal voltage should not be more than $\pm 1\%$. Ripple content in DC output with battery and without battery at charger output shall be less than 1%.

The inverter shall be of continuous duty, solid state type using proven IGBT based Pulse Width Modulation (PWM)/Quasi square wave/step wave technique. Ferro resonant types of Inverters are not acceptable. The nominal voltage output shall be 230 Volts $\pm 1\%$, single phase, 50 ± 0.1 Hz. The inverter equipment shall include all necessary circuitry and devices to conform to requirements like voltage regulation, current limiting, wave shaping, transient recovery, etc. The



total harmonic content at 100% linear load shall be less than 2% and at 100% non-linear load shall be less than 5% (Ref: IEC 62040-3) and slew rate should be 0.2 Hz/sec.

The static transfer switch shall be provided to perform the function of transferring UPS loads automatically without any break from faulty inverter to standby AC source. It should be SCR-SCR based. Transfer time – No break in sync. mode and less than 10 mS in async. Mode Manual bypass switch shall be employed for isolating the UPS during maintenance. It shall be thermomagnetic type.

Contractor has to provide Sealed Maintenance free (VRLA) type batteries for UPS. The detailed specification for the batteries has been mentioned in the battery and charger section below in this specification. An UPS having a minimum 2 hour backup for Control Room & 30 minutes backup for ICRs shall be provided for this project.

Equipment enclosures shall match and line up in assemblies of freestanding floor mounted cabinets designed for indoor service.

Individual enclosure shall be ventilated switchboard type fabricated from not less than 1.6-mm thick sheet steel. Enclosures shall be furnished with concealed hinges. Front and rear doors shall be designed to permit easy access to all components for maintenance or replacement. The enclosures shall be reinforced with formed steel members as required to form a rigid self-supporting structure. Doors shall have three-point latches.

Adequate ventilating louvers and enclosure top panels shall be included. All vent openings shall be covered with corrosion resistant fine screen coverings.

The cabinets shall be IP-42 protection class for indoor application and IP65 for outdoor application.

The temperature rise inside all the cabinets/enclosures shall not exceed 10 Deg.C above ambient temperature.

The Contractor shall also carry out the site tests on UPS as required to be conducted as a standard practice of the UPS manufacture or deemed necessary by the Employer and mutually agreed between the contractor and the client.

Modes:

a) Normal Mode Operation:

In normal mode of operation, load is connected to mains power supply through dc converter. Inverter continuously supplies stable conditioned AC power to the critical load. The rectifier and battery charger converts AC Input power to regulated DC power. This DC is in turn used for inverter input as well as for the charging of battery connected to it. With the inbuilt CVCC charger control circuit, these batteries are always maintained in fully charged and optimum operational condition.

b) Battery Mode Operation:

When the AC utility input voltage drops below the specified limits or in case of power failure or in case of rectifier malfunction, the inverter will continue to supply constant voltage to the equipment load utilizing the battery as a power source.

c) Static Bypass Operation

The continuity of power to critical load can further be maintained through static bypass in case the Inverter fails / trips. The transfer from Inverter to Bypass takes place without any interruptions if the Inverter is properly within the synchronization band. The retransfer operation from Bypass to the Inverter is possible, only in the synchronized condition.

d) Manual Bypass Operation

This feature gives the maintenance facility for UPS system by transferring the load bypass manually

Display Details:



LCD Mimic display shall be provided for UPS. Following indication on mimic should ideally be provided.

MIMIC

- INPUT/RECTIFIER OK:** Flashes in case of Mains-fail, Input Single phasing / Phase reverse, Input Under/Over-voltage, or rectifier fault such as rect. Over voltage, Rect Over temperature, DC Over voltage
- INVERTER OK:** Flashes in case of inverter fault such as Output Under/over voltage, Output Overload, Inverter Over temperature, Output short circuit, Transformer Over temperature etc.
- LOAD ON INVERTER:** Glows in case of Load on inverter.
- LOAD ON BYPASS:** Glows in case of Load on Static Bypass.
- BYPASS OK:** Glows in case of bypass voltage or frequency are ok.
- LOAD ON MANUAL BYPASS:** Glows in case of Load on Manual Bypass.
- LOAD ON BATTERY:** Flashes in case of Battery low pre-alarm, Battery low trip, Battery Over-voltage & Battery switch open.

Submission

Following are the documents that shall be submitted by the Contractor :

- Quality assurance plan (QAP).
- Schematic diagram of the UPS.
- Different calculation to support design.
- Catalogues of spares recommended with drawing indicating each items of spares.
- Copies of Type Test Certificates as per latest IEC/BIS.
- Technical literature giving complete information of the components / equipment.
- Erection, Operation and Maintenance Manual complete with all relevant information, drawings and literature for auxiliary equipment and accessories.

Makes - As per Annexure- A

Routine Test & Factory Acceptance Test - As per Annexure- B

Battery Chargers and Batteries:

For Sizing of battery and battery charger, Contractor has to submit the calculation considering the following loads (included but not limited to) with standby time of two (2) hours.

- Trip and closing Coils of all HT Breakers
- Semaphore / LED indications of the Panels for Mimics and indications
- DC supply for Protection Relay (Numeric / Electromechanical)
- Spring Charging Motors of HT Breakers (to be decided during detailed engineering).

The battery sizing shall account for suitable temperature correction factors, ageing factors of 1.25, design margin of 1.25 & depth of discharge of 80%.

The design of the battery bank and sizing calculation along with the data sheet for the battery and battery charger shall be submitted for approval.

Lead Acid Battery

Battery Ratings

Battery Voltage : To be decide during Detail Engineering

No. of Cells : To be decide during Detail Engineering

Battery type : Sealed Maintenance Free VRLA battery

Nominal discharge : 2.0V voltage per cell

Float Voltage : 2.25V/Cell

Applicable : IEC 60896-22



Standard

Equipment complying with other internationally accepted standards such as IEC, BS, etc. will also be considered if they ensure performance and constructional features equivalent or superior to standards listed above. In such a case, the Contractor shall clearly indicate the standard(s) adopted, furnish a copy in English of the latest revision of the standards along with copies of all official amendments and revisions in force as on date of opening of techno-commercial bid and shall clearly bring out the salient features for comparison.

General Technical Requirements

- DC Batteries shall be stationary lead acid Plant positive plate type conforming to IEC 60896-22. The battery shall be high discharge performance type. For the purpose of design an ambient temperature of 50 degree centigrade and relative humidity of 85% shall be considered.
- A battery bank having a minimum 2 hours backup for Inverter Room and 30 minutes backup for Control Room shall be provided for this system.
- DC Batteries shall be suitable for standby duty. The Batteries shall normally be permanently connected to the load in parallel with a charger and shall supply the load during emergency conditions when AC supplies are lost. Batteries shall be suitable for a long life under continuous float operations and occasional discharges. The batteries shall be boost charged at about 2.7 volts per cell maximum and float charged at about 2.25 V/cell.
- Batteries should be suitable for continuous operation for the maximum ambient temperature as defined in technical parameters.

Construction Feature

Containers

Containers shall be made of polypropylene plastic material. Containers shall be robust, heat resistance, leak proof, non-absorbent, alkali resistant, non-bulging type and free from flaws, such as wrinkles, cracks, blisters, pin holes etc. Electrolyte level lines shall be marked on container in case of translucent containers.

Vent Plugs

Vent plugs shall be provided in each cells. They shall be anti-splash type, having more than one exit hole shall allow the gases to escape freely but shall prevent alkali from coming out. The design shall be such that the water loss due to evaporation is kept to minimum. In addition the ventilator shall be easily removed for topping up the cells and of such dimensions that the syringe type hydrometer can be inserted into the vent to take electrolyte samples.

Plates

The plates shall be designed for maximum durability during all service conditions including high rate of discharge and rapid fluctuations of load. The construction of plates shall conform to latest revisions of IEC/OES Standard.

The separators shall maintain the electrical insulation between the plates and shall allow the electrolyte to flow freely. Separators should be suitable for continuous immersion in the electrolyte without distortion.

The positive and negative terminal posts shall be clearly marked.

Sediment Space

Sufficient sediment space shall be provided so that cells will not have to be cleaned during normal life and prevent shorts within the cells.

Electrolyte

The electrolyte shall be prepared from battery grade potassium hydroxide conforming to IEC

60993.

The cells can be shipped either in charged condition or in dry condition Necessary electrolyte for makeup shall be supplied separately.

Connectors and Fasteners

Nickel plated copper connectors shall be used for connecting adjacent cells and PVC insulated flexible copper cables shall be used for inter-row / inter-tier / inter-bank connections. Bolts, nuts and washers shall be Stainless Steel / Nickel coated steel to prevent corrosion. The thickness of Nickel coating of connectors should be not less than 0.02 mm. All the terminals and cells inter-connectors shall be fully insulated or have insulation shrouds. End take off connections from positive and negative poles of batteries shall be made by single core cables having stranded CU conductors and XLPE insulation. Necessary supports and lugs for termination of these cables on batteries shall also be supplied by the contractor. All connectors and lugs shall be capable of continuously carrying the 30 minutes discharge current of the respective batteries and through fault short circuit current which the battery can produce and withstand for the period declared. Contractor shall furnish necessary sizing calculations to prove compliance to the same. Suitable number of Inter-rack connectors shall be supplied by the Contractor to suit the battery room layout during detailed engineering.

Battery racks

Mild steel racks for all the batteries shall be provided. They shall be free standing type mounted on porcelain/hard rubber/PVC pads insulators/High impact plastic insulators.

Batteries shall preferably be located in the single tier arrangement. However, batteries having a complete cell weight of lower than 50 Kg could be located in the double tier arrangement. The batteries racks and supports for cable termination shall be coated with three (3) coats of anti-alkali paint of approved shade. Name plates, resistant to alkali, for each cell shall be attached on to the necessary racks. The bottom tier of the stand shall not be less than 150 mm above the floor.

Wherever racks are transported in dismantled conditions, match markings shall be provided to facilitate easy assembly.

Manufacturer's Identification System

The following information shall be indelibly marked on outside of each cell.

- Manufacturers name and trade marks
- Country and year of manufacture.
- Manufacturer type designation.
- AH capacity at 6 hour discharge rate.
- Serial number

Instruction Card Supplied With Battery

- Manufacturer's instructions for filling and initial charging of the battery together with starting and finishing charging rate.
- Maintenance instructions.
- Storing conditions of electrolyte.

Dual Float And Boost Battery Charger

Charger

- The battery charger shall be dual float and boost charger. The Battery Chargers as well as their automatic regulators shall be of static type. Battery chargers shall be capable of continuous operation at the respective rated load in Trickle mode i.e. Trickle charging the associated DC lead-acid Batteries while supplying the D.C. loads. The Batteries shall be Trickle charged at 2.25 Volts per cell. All chargers shall also be capable of Boost



- The Charger manufacturer may offer an arrangement in which the voltage setting device for Trickle charging mode is also used as output voltage limit setting device for Boost charging mode, and the load limiter of the trickle charging mode is also used as Boost charging current setting device.
- Suitable filter circuits shall be provided in all the Chargers to limit the ripple content (peak to peak) in the output voltage to 1% irrespective of the DC load, even when they are not connected to a battery.
- The DC System shall be ungrounded and float with respect to the ground potential when healthy. An earth fault relay shall be provided by the contractor in the DC distribution board for remote annunciation.
- Digital Outputs shall be configured for connection to the Solar SCADA for real- time charger status updatation. Outputs like charger output current, output voltage, float/boost mode, etc. may be configured to provide the update to SCADA.

Printed Circuits Boards (PCB)

PCB shall be made of glass epoxy of 1.6 mm thick, fire resistant, bonded with 99.8% pure copper foil, free of wrinkles, blisters, scratches and pinholes. The contact surface of the edge connectors of the PCBs shall be plated with hard gold to a minimum thickness of 5 microns. Component identification shall be printed on PCB by silk screen method. All PCBs shall be tropicalized and masked.

Contactors

All Battery Chargers shall have an AC contactor on the input side. It shall be of air break type and suitable for continuous duty. The operating coil shall be rated for 415 Volts AC.

Thermal Overload Relay

A thermal overload relay incorporating a distinct single phasing protection (using differential movement of bimetal strips) shall also be provided for the AC input. The relay shall trip the above contactor.

Rectifier-Transformers and Chokes

The rectifier transformer and chokes shall be dry and air cooled (AN) type. The rating of the rectifier-transformers and chokes shall correspond to the rating of the associated rectifier assembly. The rectifier-transformers and chokes shall have Class-B insulation with temperature rise limited to class-A insulation value.

Rectifier Assembly

The rectifier assembly shall be full wave bridge type and designed to meet the duty as required by the respective Charger. The rectifier cells shall be provided with their own heat dissipation arrangement with natural air cooling. The rectifier shall utilize diodes/thyristors and heat sinks rated to carry 200% of the load current continuously and the temperature of the heat sink shall not be permitted to exceed 85°C absolute duly considering the maximum charger panel inside temperature. The Contractor shall submit calculations to show what maximum junction temperature will be and what the heat sink temperature will be when operating at 200% and 100% load current continuously duly considering the maximum surrounding air temperature for these devices inside the charger panel assuming air ambient temperature of 50°C outside the panel. Necessary surge protection devices and rectifier type fast acting fuses shall be provided in each arm of the rectifier connections.

Digital Indicating Instruments

Digital indicating instruments with built in communication port for remote data transfer shall be provided for all chargers. The instruments shall indicate DC current, DC voltage & AC voltage and instrument shall be 96 x 96 mm², with display accuracy 0.5%, 4 digit-7 segment LED/LCD



display and RS 485 Serial Bus port.

Air Break Switches

All Chargers shall have AC input and DC output switches of air break, single throw, load break and fault make type. The contacts of the switches shall open and close with a snap action. Switches shall be rated for 120% of the maximum continuous load. "ON" & "OFF" position of the switch shall be clearly indicated.

Fuses shall be of HRC cartridge fuse link type. Fuses shall be mounted on fuse carriers which are mounted on fuse bases. Wherever it is not possible to mount fuses on fuse carriers, fuses shall be directly mounted on plug in type bases. In such cases one insulated fuse pulling handle shall be supplied for each charger. Kick-off fuses (trip fuses) with alarm contacts shall be provided for all D.C. fuses.

Indicating Lamps

Three (3) indicating lamps shall be provided to indicate A.C. supply availability. The indicating lamp shall be of panel mounting, filament type low wattage or LEDs and capable of clear status indication under the normal room illumination. The lamps shall be provided with series resistors (non-hygroscopic) preferably built in the lamp assembly and replaceable from front. The lamp covers shall be preferably screwed type, unbreakable and moulded from heat resistant material.

Blocking Diode

Blocking diode shall be provided in the output circuit of each Charger to prevent current flow from the D.C. Battery into the Charger.

Annunciation System

Visual indications through indicating lamps/LEDs or annunciation facia as per EEUA-45D shall be provided in all Chargers for the following:

- A.C. supply failure
- Rectifier fuse failure
- Surge circuit fuse failure
- Filter fuse failure
- Load limiter operated
- Charger trip
- Battery on Boost
- Potential free NO contacts of all above conditions shall be provided for following remote alarms in the SCADA
- Battery on Boost Charger trouble (this being a group alarm initiated by any of the faults other than "Battery on Boost")

Name Plates and Marking

The name plates shall be made of non-rusting metal/3 ply Lamicoid and shall have black background with white engraved letters and secured by screws. These shall be provided near top edge on the front as well as on rear side of Charger. Name plates with full and clear inscriptions shall also be provided on and inside the panels for identification of the various equipment.

Construction

The Chargers shall be indoor, floor mounted, self-supporting sheet metal enclosed cubicle type. The Contractor shall supply all necessary base frames, anchor bolts and hardware. The Charger shall be fabricated using cold rolled sheet steel shall not less than 1.6 mm and shall have folded type of construction. The panel frame shall be fabricated using cold rolled sheet steel of thickness not less than 2.0 mm. Removable undrilled gland plates of at least 3.0 mm sheet steel and lugs for all cables shall be supplied by the Contractor. The lugs for cables shall be made of electrolytic copper with tin coat. Cable sizes shall be advised to the Contractor at a



later date for provision of suitable lugs and gland plates. The Charger shall be tropicalized and vermin proof. Ventilation louvers shall be backed with fine brass wire mesh. All doors and covers shall be fitted with synthetic rubber gaskets. The Chargers shall have hinged double leaf doors provided on front and/or backside for adequate access to the Charger internals. All the Charger cubicle doors shall be properly earthed. The degree of protection of Charger enclosure shall be at least IP-42.

All indicating instruments, control & selector switches and indicating lamps shall be mounted on the front side of the Charger. Design of panel shall be based on the following dimensions.

- Overall height : Maximum 2350 mm
- Operating handles : Maximum 1800 mm, Minimum 350 mm (highest and lowest positions reached by operator's hands)
- Doors and panel : Maximum 1800 mm, Minimum 300 mm handles and lock

The arrangement of Charger components shall be such that their heat losses do not give rise to excessive temperature within the Charger panel surface. Location of the electronic modules will be such that temperature rise of the location, in no case, will exceed 10°C. over ambient air temperature outside the Charger.

Following minimum protections shall be provided in charger,

- The charger shall be protected against overloads by having suitable characteristics so that all loads in excess of the capacity of the charger would be transferred to the battery.
- Charger shall go in current limiting mode if battery current or charger Current exceeds the set value.
- Charger shall trip in case input voltage decreases beyond set value.
- Charger shall trip in case of D.C. voltage is increased.
- D.C. current is increased beyond set value.

Following indications, metering and protections shall be provided on battery charger unit;

- A.C. Input supply ON,
- D.C. supply ON,
- Charger ON,
- Battery on LOAD,
- Battery under voltage and over voltage,
- Battery Charger Failure,
- Input A.C. supply Voltmeter with selector switch,
- Input A.C. Ammeter with selector switch,
- Output D.C. supply Voltmeter with selector switch,
- Output D.C. Ammeter with selector switch,
- Under voltage Relay to isolate battery from load when voltage drops less than 80 % of set value.
- Fault annunciation such as control card failure, thyristor failure, fuse failure etc.
- Charging voltage and current adjustment potentials.
- Appropriate ventilation arrangements to be provided in battery rooms. This shall
- Essentially consist of sufficient air inlet and exhaust provisions.
- DC distribution board shall consist of incoming from battery bank and no of outgoings for closing coil and tripping coil, spring charging motors & Control and Relay panel and switchyard equipment. A separate circuit for emergency loads to be provided in the event of AC supply failure.



Following are the documents that shall be submitted by the Contractor :

- Quality assurance plan (QAP).
- Schematic diagram of the Battery, Battery charger & DCDB.
- Battery rack drawings
- Different calculation to support design.
- Catalogues of spares recommended with drawing indicating each items of spares.
- Copies of Type Test Certificates as per latest OES/IEC/BIS.
- Technical literature giving complete information of the components / equipment.
- Erection, Operation and Maintenance Manual complete with all relevant information, drawings and literature for auxiliary equipment and accessories.

Makes - As per Annexure- A

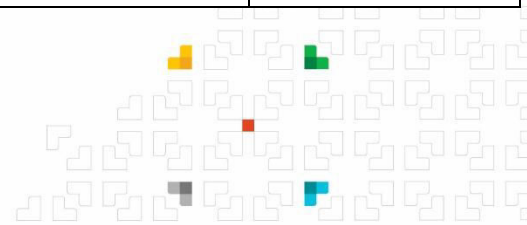
Routine Test & Factory Acceptance Test - As per Annexure- B

Auxiliary Power Supply System

Auxiliary power supply arrangement shall be as per approved aux. SLD. Each Inverter Room / MCR room shall have its own auxiliary power supply system comprising of AC distribution board (ACDB) which shall be fed from LV side of Inverter transformer through suitably rated auxiliary transformers. All ACDB's shall have two incomers (100% rated) fed from two different sources. At MCR, auxiliary transformer directly feed from 11 kV switchgear are also acceptable. 20% future load margin shall be taken while arriving kVA capacity of auxiliary transformer, The minimum kVA capacity of auxiliary transformer for Inverter Room and MCR requirement shall be as per approved calculation of auxiliary transformer.

All non-critical auxiliary loads shall be fed directly from ACDB. However, emergency and important load shall be fed from suitable sized Uninterrupted Power Supply (UPS) or Battery Charger. Input AC supply for Uninterrupted Power Supply (UPS) and Battery Charger shall be fed from ACDB. Contractor shall consider the following one of the supply option for feeding different equipment loads:

Equipment Name	Option-1 ACDB	Option-2 UPS	Option-3 Battery charger
SCADA including remote RTU/IO panel		✓	✓
SCADA HMI		✓	✓
Data logger		✓	✓
Fire Detection /Alarm Panel		✓	✓
Emergency Lighting		✓	✓
CCTV		✓	✓
HMI of SCADA		✓	✓
Inverter's Auxiliary supply (if applicable)		✓	✓
Energy Meter/MFM		✓	✓
Switchgear spring charging motor		✓	✓
switchgear space heater	✓		
Illumination, Fan supply etc.	✓		





Equipment Name	Option-1 ACDB	Option-2 UPS	Option-3 Battery charger
Module washing system	✓		
Other non-critical auxiliary loads	✓		

- Each UPS shall consist of 1x100% charger and inverter, 1 x 100% Battery bank for providing 120 minutes backup. Bypass Line static switch, manual bypass switch, 1 x 100% UPSDB, and other necessary Protective devices and accessories.
- In place of UPS, contractor can provide DC supply system (1 x 100% Battery Charger) of 12V or above up to 110V DC if the auxiliary power supply requirement of loads is in DC.
- The rated AC output capacity shall be taken for UPS battery size calculation. All UPS having rating 5KVA or more shall have three phase input.
- The Contractor can provide alternate arrangement with suitable redundancies such as power pack with 30 minute backup for switchgears.
- Each Battery charger system shall consist of 1 x 100% charger and 1 x 100% Battery bank for min 240 minutes back up and 1 x 100% DCDB, and other necessary protective devices and accessories. DC supply system voltage shall be 110V DC.
- It is mandatory to use Battery charger system for control and protection supply of main control room HT switchgear.
- Contractor shall submit configuration diagram, power supply distribution scheme, single line diagram and data sheets, all calculations such as Rectifier Modules/UPS Charger/Inverter rating calculations, battery sizing calculation etc. for UPS, Battery Charger & Battery system during detailed engineering stage for employer's review and approval.
- Size and rating of UPS, Battery Charger and Battery shall be finalized during details engineering stage.

Auxiliary Transformer

Auxiliary transformers shall be suitable for 3 phases, 4 wire system with additional LVN bushing for equipment earthing.

Auxiliary Transformer up to and including 20 kVA can be either Oil filled or Dry Type (refer relevant specification). All transformer of size greater than 20 kVA shall necessarily be oil filled type. If auxiliary transformer is provided indoor, it shall be necessarily dry type. Further Auxiliary transformer must be capable of handling Non- Sinusoidal Voltage with voltage gradient as per relevant applicable standard and Inverter manufacturer's recommendation.

For dry type transformer, Winding temperature indicator with RTD sensor for continuous monitoring for winding temperature has to be provided. In case of winding temperature goes beyond set value, incoming supply to transformer should be disconnect.

Contacts from Auxiliary transformer fittings/protection devices shall be wired for tripping of auxiliary transformer Circuit Breaker. Detailed scheme regarding same shall be finalized during detailed engineering.

Bidder to ensure that load list used to calculate final size of Aux transformer is in sync with aux losses taken in PVSyst generation simulations.

Codes And Standards

Description	Standard
Transformers:	IEC: 60076



Bushings:	IEC: 60137
Insulating oil:	IEC 60296
Bushing CTs:	IEC 60185

General Construction

Transformer shall be constructed in accordance to applicable OES & IEC standard. Transformer shall be complete & functional in all respect and shall be in scope of supplier.

The other important construction particulars shall be as below.

- The Transformer tank and cover shall be fabricated from high grade low carbon plate steel of tested quality. The tank and the cover shall be of welded construction and there should be provision for lifting by crane.
- Suitable Inspection hole(s) with welded flange(s) and bolted cover(s) shall be provided on the tank cover. The inspection hole(s) shall be of sufficient size to afford easy access to the lower ends of the bushings, terminals etc.
- All bolted connections to the tank shall be fitted with suitable oil-tight gaskets which shall give satisfactory service under the operating conditions for complete life of the transformer if not opened for maintenance at site.
- Transformer shall have adequate capacity Conservator tank to accommodate oil preservation system and volumetric expansion of total transformer oil.
- Transformer shall have Oil Temperature Indicator and Winding Temperature Indicator (WTI applicable for transformer above 50 KVA) with accuracy class of +/-2 deg.
- For Transformers above 100KVA, radiators shall be detachable type, mounted on the tank with shut off valve at each point of connection to the tank, lifts, along with drain plug/valve at the bottom and air release plug at the top.
- Marshalling Box shall be of sheet steel, dust and vermin proof provided with proper lighting and thermostatically controlled space heaters. The degree of protection shall be IP 55. Marshalling Box of all transformers shall be preferably Tank Mounted. One dummy terminal block in between each trip wire terminal shall be provided. At least
- 20% spare terminals shall be provided on each panel. The gasket used shall be of neoprene rubber. Also Marshalling Box, shall be at least 450 mm above ground level (for transformer above 100 KVA). For transformer above 100 KVA, wiring scheme (TB details) shall be engraved in a stainless steel plate with viewable font size and the same shall be fixed inside the Marshalling Box door.

Windings

- The Contractor shall ensure that windings of all transformers are made in dust proof & conditioned atmosphere.
- The conductors shall be of electrolytic grade copper free from scales & burrs.
- All windings of the transformers shall have uniform insulation.
- Tapping shall be so arranged as to preserve the magnetic balance of the transformer at all voltage ratios.

Core

- The core shall be constructed from non-ageing, cold rolled, super grain-oriented silicon steel laminations equivalent to M4 grade steels or better.
- Core isolation level shall be 2 kV (rms.) for 1 minute in air.
- Adequate lifting lugs will be provided to enable the core & windings to be lifted.

Insulating Oil

P.O.Box 1707, CPO, PC 111
C.R. 1/6886/77
Sultanate of Oman
ص.ب. ١٧٠٧، البريد المركزي ١١١
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هاتف +٩٦٨ ٢٤٢٥ ٠٠٠٠

F +968 2425 0003

فاكس +٩٦٨ ٢٤٢٥ ٠٠٠٣

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No inhibitors shall be used in the transformer oil. The oil supplied with transformers shall be new and previously unused and must conform to following while tested at supplier's premises and shall have following parameter.

Bushings

- Bushing below 52 kV shall be oil communicating type with porcelain insulator.
- No arcing horns to be provided on the bushings.
- Inverter Transformer LV bushing palms shall be silver/tin plated.

Bushing CTs

- Shall be of adequate rating for protection as required, WTI (WTI CT applicable for transformer above 50 KVA) etc. All CTs (except WTI) shall be mounted in the turret of bushings, mounting inside the tank is not permitted.
- All CT terminals shall be provided as fixed type terminals on the Marshalling. Box to avoid any hazard due to loose connection leading to CT opening. In no circumstances Plug in type connectors shall be used for CT.

Valves

All valves up to and including 50 mm shall be of gun metal or of cast steel. Larger valves may be of gun metal or may have cast iron bodies. Sampling & drain valves should have zero leakage rate.

Gaskets

- Gasket shall be fitted with weatherproof, hot oil resistant, rubberized cork gasket.
- If gasket is compressible, metallic stops shall be provided to prevent over compression.
- The gaskets shall not deteriorate during the life of transformer if not opened for maintenance at site. All joints flanged or welded associated with oil shall be such that no oil leakage or sweating occurs during the life of transformer. The quality of these joints is considered established, only if the joints do not exhibit any oil leakage or sweating for a continuous period of at least 3 months during the guarantee period. In case any sweating / leakage is observed, contractor shall rectify the same & establish for a further period of 3 months of the same. If it is not established during the guaranteed period, the guaranteed period shall be extended until the performance is established.

Neutral Earthing Arrangement

Neutral earthing shall be done as per system requirement. In case of solidly earthed neutral of Transformers, it shall be brought through insulated support from tank to the ground level at a convenient point with 2 nos. copper flat, for connection to ground network (as applicable).

Cable Boxes & Disconnecting Chamber

- HV Cable boxes shall be of phase segregated air insulated type & shall be of sufficient size to accommodate Employer's cable & termination. Phase segregation shall be achieved by insulating barriers (for 3.3 kV and above side)
- Cable boxes shall have bus bars / suitable terminal connectors of adequate size & bolt holes to receive cable lugs.
- A suitable removable gland plate of non-magnetic material drilled as per the Employer's instruction shall also be provided in the cable box.
- The support from base for the cable box (for 3.3 kV and above side) shall be of galvanized iron
- The contractor shall provide earthing terminals on the cable box, to suit Employer's CU flat.

The minimum length provided for terminating 33 kV & 3.3 kV XLPE cable shall be 1000 mm (for 33 kV) 650 mm (for 3.3 kV) from cable gland plate to the cable lug for the cable



boxes, for 415V side suitable length shall be provided (shall be discussed during detail engineering). The final cable size, number & length of terminating XLPE cable shall be furnished during detailed engineering.

- Cable boxes shall be designed such that it shall be possible to move away the transformer without disturbing the cable terminations, leaving the cable box on external supports (as applicable).
- Cable boxes shall have removable top cover (for transformer above 100 KVA) & ample clearance shall be provided to enable either transformer or each cable to be subjected separately to high voltage test.

Fittings

- Conservator for main tank (transformer above 100 KVA shall be provided with MOG with low oil level alarm contact), drain valve & indicating type free Cobalt free breather with transparent enclosure (maximum height 1400 mm above ground level) etc.
- For Auxiliary transformers below 2 MVA, diaphragm type explosion vent shall be provided.
- OTI & WTI shall be 150 mm dial type with alarm (WTI only for transformer above 50 kVA) and trip contacts with max. Reading pointer & resetting device (maximum height 1500 mm above ground level).
- For transformer above 100 KVA: Top & bottom filter valves with threaded male adapters, bottom sampling valve, drain valve/sludge removal valve at the bottom most point of the tank.
- For Transformer up to 100 KVA: common drain, sampling, bottom filter, sludge removal valve and top filter valve can be provided.
- Air release plug, bushing with metal parts & gaskets, terminal connectors on bushings (as applicable).
- Prismatic/toughened glass oil gauge for transformers.
- Bi-directional wheel/skids, Marshalling Box, OCTC, Bushing CTs (as applicable), Insulating Oil, Cooling equipment.
- Cover lifting eyes, transformer lifting lugs, jacking pads (jacking pad applicable for transformer above 100 KVA), towing holes and core and winding lifting lugs, inspection cover, Bilingual R&D Plate, Terminal marking plates, two nos. earthing terminals etc.
- Bolts & nuts (exposed to atmosphere) shall be galvanized steel/SS.
- Rain hoods to be provided on Buchholz, MOG & PRD. Entry points of wires shall be suitably sealed.
- The fittings listed above are only indicative and other fittings, which generally are required for satisfactory operation of the transformers are deemed to be included.

Tests And Inspection

- Contractor shall offer type tested transformer(s) including short circuit test (as per IEC 60076 part-5) for the project.
- In case the Contractor /contractor has conducted type test(s) specified in the specification within last ten years, he may submit the type test reports to the owner for waiver of conductance of such type test(s). These reports should be for the tests conducted on the equipment similar to those proposed to be supplied under this contract and test(s) should have been either conducted at an independent laboratory or should have been witnessed by a client.

Dry Type Auxiliary Transformers

Dry Type Transformer shall be constructed in accordance with IEC /OES standard. Transformer



rating and all related technical parameter including tap changer (if applicable) shall be as per system requirement/SLD and relevant standards. Transformer shall be suitable for continuous indoor duty application. Transformer shall be complete & functional in all respect. The other important construction particulars shall be as below.

- The transformers shall be housed in a metal protective housing, having a degree of protection of IP-23. The enclosure shall be provided with suitable hardware (as required).
- The conductors shall be of electrolytic grade copper free from scales & burrs.
- Dry Type Transformer windings shall be of class F insulation or better.
- Cooling shall be AN.
- The core shall be constructed from non-ageing, cold rolled, grain-oriented silicon steel laminations (M4 or better).
- The fittings/accessories including protection/monitoring device (temperature scanner) generally required for satisfactory operation of the transformer, are to be provided.

Makes - As per Annexure- A

Routine Test & Factory Acceptance Test - As per Annexure- B

CCTV Surveillance System

For each ICR block of solar plant, 1 nos. PTZ at locations (in the field) specified by the client shall be provided.. It may be increase according to layout requirement hence contractor has to provide the same at no cost. Also, bullet or Dome cameras shall be provided at each Main Control Room, switchyard & main gate.

For Plant Boundary surveillance Watch Tower (Minimum 4 Nos) or PTZ camera to be provide by Contractor. Shadow of CCTV pole & Watch Tower should not fall under the PV area. Finalized strategy shall ensure that 100% of plant periphery is monitored.

Storage capacity of 1 Month, as per standard practice. But the NVR should have the capability to transfer the data to backup storage. These CCTV cameras shall be monitored from outside through high speed net (provision to be created by the contractor and the pertaining recurring costs to be included in the O&M costs) for monitoring purpose.

Following are the specifications of the CCTV cameras:

- IP Metal Bullet camera (Suitable for Outdoor duty -IP66) with 20m IR coverage range & Day night vision
- HDG pole for CCTV Mounting
- PTZ camera (Suitable for Indoor duty) with 20m IR coverage range & Day night vision
- Channel NVR (Up to 4MP supported) with 30 Days 24X7 Storage facility with min. 2TB Surveillance HDD
- channel gigabit media converter for connect all camera output & connect to network switch Via cat-6 cable (where distance between camera & switch is more than 90 mtr)
- POE (Power over Ethernet) Injectors (4 channel)
- 32" LED Color Monitor for CCTV monitoring
- Auxiliary Power supply cable for POE (media converter)

Makes - As per Annexure- A

Cable Termination and Straight Through Joint

- Termination and jointing kits for 11 kV and 1.9/3.3 kV grade XLPE insulated cables shall be of proven design and make which have already been extensively used and type tested.
- Termination kits and jointing kits shall be pre-moulded type, taped type or heat shrinkable type.



- 11kV joints and terminations shall be type tested as per applicable OES & IEC Standards.
- 1.9/3.3 kV grade joints and terminations shall be type tested as per VDE0278.
- Critical components used in cable accessories shall be of tested and proven quality as per relevant product specification/ ESI specification.
- Kit contents shall be supplied from the same source as were used for type testing.
- Straight through joint and termination shall be capable of withstanding the fault level for the system.
- Preferably, over the surface, adequately IP rated MV splicing cabinets shall be used for splices in a single feeder. Alternatively, cable spools shall be of adequate length to avoid such joints.

Area Lighting

All the main and internal roads shall be lit with external lighting system strategizing site security and maintenance requirements; utmost care should be taken for avoiding any shading effect due to the poles. The light fittings shall be highly efficient having longer life. LED based system shall be used. The connecting wires used inside the system shall be low smoke halogen free, fire retardant, PTFE cable and fuse protection should be provided at the input side for LV luminaries. At most care should be taken to avoid any shading effect due to lighting poles. LED drivers should have suitable precision current control O/C, S/C, over temperature, overload protection and can be timer programmed.

Minimum 5 Lux shall be acceptable across approach and periphery road and Average 250 lux at Inverter station, 250 lux at MCR, 300 lux in switchgear area, admin room, SCADA room, and 250 lux at inverter room, 150 Lux at switchyard equipment vicinity and 20 lux at switchyard general area; however, all provisions of the IFC guidelines need to be followed in case they are higher than the prescribed minimum standards. The entire plant lighting arrangement shall be fed from auxiliary power supply system available at the plant. Minimum 20% lights shall be used for emergency lighting scenario with backup of 2 hours.

2 nos. of Mobile light mast to be provided for the lighting of the solar field during module cleaning or O&M related work in night time.

WMS

Contractor shall provide weather-monitoring sensor to provide adequate meteorological data to evaluate system performance. Station shall essentially include sensors but not limited to monitoring of global irradiation on tilted plain, ambient temperature, module temperature, wind speed and direction.

Dedicated Pyranometer shall be used for measurement of global irradiation on tilted plain. Only Kipp & Zonen or equivalent make Pyranometer shall be used in weather station.

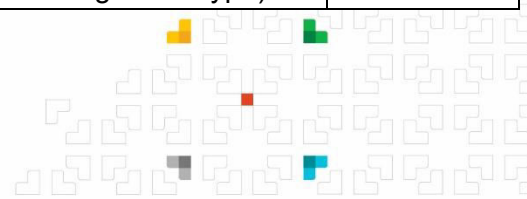
Weather station along with data logger (Recording resolution of 1 minute) shall be located at strategic point and shall be capable of collecting the data points and sample frequency. The weather Station shall have capability of recording and storing environmental data without AC power for seven (7) days. Main auxiliary power to be provided from nearest UPS DB. Also, on device data storage should be provided with an internal SD card of suitable capacity for minimum 30 days storage. The data should be readable in.csv format and should be downloadable by an external USB port. The length of the data cable from any of the sensor to data logger shall not exceed 20 m. The accuracy of any of the following sensors should be as per manufacture. All the data collected from the weather monitoring station should be transferred and stored in the SCADA system.



1.	Ambient Temperature Sensor & Relative Humidity Sensor with solar shield Ambient Temperature Sensor: Range: - 5 °C to + 95°C, Accuracy: $\pm 0.1^{\circ}\text{C}$. over 0 to 70°C range, Resolution: 0.1°C , Units of Measure: $^{\circ}\text{C}$ Relative Humidity Sensor: Range:- 0 to 100% RH Accuracy $\pm 2\%$	1 Nos Each
2.	Barometric Pressure Sensor Range 650 – 1100 hPa, Accuracy $\pm 0.3\text{ hPa}$	1 Nos
3.	Global Irradiation Pyranometer: Classification to ISO 9060:1990 - Secondary Standard and IEC 60904 standards Spectral range (50% points) - 285 to 2800nm Sensitivity - 7 to 14 V/W/m ² Impedance - 10 to 100 Ω Expected output range (0 to 1500 W/m ²)- 0 to 20mV Maximum operational irradiance - 4000 W/m ² Response time (63%) < 1.7s Response time (95%) < 5s Non-stability (change/year) < 0.5% Non-linearity (100 to 1000 W/m ²) < 0.2% Directional response (up to 80° with 1000 W/m ² beam) < 10 W/m ² Tilt response (0° to 90° at 1000 W/m ²) < 0.2% Detector type - Thermopile Operational temperature range - -40°C to +80°C Humidity range - 0 to 100% non-condensing Ingress Protection (IP) rating - 67 Application - Meteorological networks, PV panel and thermal collector testing, materials testing	1 Nos – GHI
4.	Tilted Irradiation Pyranometer: Specification As mentioned above (C)	1 Nos – POA
5.	Solar Radiation Sensor Mount Kit : For Horizontal Mount : Consists of a rectangular plate, mounting bracket, and mounting hardware. Dimensions and weight should be as per requirement. For Tilted Mount : Consists of a rectangular plate, mounting bracket, and mounting hardware, Includes slots that can be adjusted to any angle from horizontal to vertical.	2 Nos
6.	Module Temperature Sensor : The sensor should be in silicon rubber under self-adhesive aluminium film. After removing protective film, it can be glued directly on the surface to be monitored. To be ensured that sensor holds over entire plant life cycle. Sensor Element : resistance thermometer (thin film) with four connections in accordance with DIN 43760 and BS 1904 Operating temperature : -35 to 100°C	3 Nos



7.	Rainfall Type: Professional Quality Tipping Bucket Rain Gauge or Impact Sensor or Optical Sensor Accuracy: 0.1 mm Resolution: 0.25 mm precipitation per measurement Units of Measure: Rain-rate in mm/hr and Rainfall accumulation Measurement Data Rate: Configurable Rate (1s, 10s, 1m etc.)	1 Nos
8.	Anemometer Wind Speed : Range: 0.5 to 60 m/sec, Accuracy ± 0.3 m/sec (≤ 10 m/sec) and $\pm 2\%$ (≥ 10 m/sec), Resolution 1.0 unit, Units of Measure Wind Speed: m/s and km/h Wind Direction : Range 0 – 360°, Accuracy $\pm 0.1^\circ$, Units Displayed East, West, North, South, N-E, N-W, S-E & S-W	1 Nos
9.	Soiling Station Soil Monitoring Station – Dust IQ	1 Nos
10.	Stand Alone Power Supply Arrangement Power Supply Charger/Regulator: 12 VDC, 100% solid state, True 0 to 100% PWM duty cycle, Rated for 25% overloads, Fully encapsulated in epoxy potting, Marine rated terminals/anodized case, Temperature compensation, Green charging/Red LVD indicators, Approved for use in hazardous locations – Class 1, Division 2, Groups A, B, C, D. Operating Temp. -0 to +60°C. Solar Panel: as per requirement with lead	1 Nos
11.	Mounting Hardware Supply of 3 m long tripod made from corrosion resistant galvanised steel. It should support the attachment of sensors and mounts, solar panel and environmental enclosures with individually adjustable legs to allow installation over uneven terrain along with lightning and grounding rods, grounding cables, grounding cable clamps, grounding stakes and UV resistant cable ties. One guy kit to be provided to improve the wind load withstand capacity.	1 Nos
12.	Measurement And Control Data Logger: GPS based Digital Data logger with inbuilt memory and support for using external memory like Pen drive. Data Storage for minimum 30 days and Data backup facility Data logger should provide site location and timing information. Analogue Inputs, A/D Bits, Serial Inputs : As per requirement Serial Output: RS485 (For interface with scada) Wireless Communication: Built-In GSM/GPRS Modem Power Supply: Stand Alone system to be provided Operating Temperature: 0°C to +60°C Protection Class: IP66 Operating Humidity: 0% to 95% humidity Enclosure Material should be Acid-Proof, Rust-Proof and UV stabilized Battery Backup: Internal Battery (Li-ion only, rechargeable type) of	1 Nos





	<p>sufficient capacity to be provided for minimum backup of 7 days. Battery Charging/Regulator with Charge/Recharge control and Deep discharge protection to be provided.</p> <p>Display: Graphic LCD</p> <p>Sensor Module Software: Vendor shall provide real-time display software. It should be capable of retrieving the data from the solid state recorder and present the data in Excel Importable format. The software should also generate reports (Daily/Weekly/Monthly and Yearly) in Word or PDF format. Necessary Interface and Data cables to be provided.</p>	
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Makes - As per Annexure- A

SCADA

Solar Project requires a comprehensive —Plant SCADA and Remote Monitoring System”, covering both DC and AC sides along with **Zero Export arrangement (Reverse Power Protection) at Grid Incomer 132kV & DG Synchronization/Interlock arrangement.** Necessary CT & PT (for all 3 Phase) tapings are not available in Existing 132kV Switchgear panel, contractor has to install new sets of required rating CT & PT in Existing Switchgear. Any design, sizing and modifications required for achieving above functionality, in clients existing switchgear panels needs to be done with prior approval of client. The necessary single line diagrams can be provided on request.

The scope includes design, supply, erection and commissioning of SCADA and Remote Monitoring & Controlling System with all accessories, auxiliaries and associated equipment and cables for the safe, efficient and reliable operation of entire solar plant and its auxiliary systems at the plant.

Contractor shall include in his proposal all the Hardware, Software, Panels, Redundant Power Supply, HMI, Laser Printer, Gateway, GPS clock, Firewall, Networking equipment and associated Cable etc. needed for the completeness even if the same are not specifically appearing in these specifications.

Contractor also needs to provide Power Plant Controller (PPC) functionality.

SCADA System shall have the provision to perform the following functions:

- Real-time acquisition and display of data, status, alarms and trends
- Display of status of major equipment in Single Line Diagram (SLD) format
- Monitoring & Control of switchgears and Inverters
- Display and storage of measured values
- Display and storage of derived/calculated/integrated values
- Display and Storage of Alarm, Event and Trends
- Generate, store and retrieve user configurable Sequence of Event (SOE) Reports
- Generate, store and retrieve user configurable periodic reports.
- SCADA shall have facility to generate report in MS Excel file type.
- Remote monitoring of essential parameters on the web authorized with user id and password using standard modem (Internet connection for transferring data to web shall be taken by Contractor in the name of Solar Project Site for O & M period).
- System self-supervision

SCADA shall have provision to control (Switch On/Switch Off) all the MV/HV/EHV Breakers and Inverters either in hard wire signal and shall have facility to control Inverter active and reactive power as per requirement mentioned in respective chapter. SCADA shall also be able to acquire real time Data, Status and Alarm from following equipment included but not limited to as required



or offered under the scope of this specification:

- i. All the MV/HV Switchgear Equipment
- ii. LV Switchgear Panel
- iii. UPS and Battery charger as approved in Detail Engineering
- iv. Weather Monitoring Equipment
- v. Multi-function meter
- vi. Numerical Relay
- vii. Fire Alarm Panel
- viii. Tariff Energy Meter
- ix. String Inverter
- x. GPS Time Synchronization unit
- xi. SCADA Hardware, Accessories and Communication link
- xii. Inverter Duty Transformer and Auxiliary Transformer
- xiii. Any other equipment required as per specification
 - Type of signal from equipment (Hard wired Only) shall be as per specification of the equipment mentioned in the respective chapter and approved during detail engineering.
 - SCADA shall provide real time performance monitoring according to IEC 61724 & as per applicable OES standard. In case of conflict between this specification and those (IEC codes, standards, etc.) referred to herein, the former shall prevail.
 - An industrial redundant fiber optic network and Ethernet LAN (as per application) shall be distributed throughout the field for communication to field devices.
 - At main control room/MCR room, it shall be possible to remove/replace online various modules (like any I/O module, interface module, etc.) from its slot for maintenance purpose without switching off power supply to the corresponding rack. System design shall ensure that while doing so, undefined signaling and releases do not occur and controller operation in any way is not affected (including controller trip to manual, etc.) except that information related to removed module is not available to controller. The on-line removal/insertion of controller, I/O modules shall in no way affect the safety of plant and personnel.
 - The control system shall provide safe operation under all plant disturbances and on component failure so that under no condition the safety of plant, personnel or equipment is affected. Control system shall be designed to prevent abnormal swings due to loss of Control System power supply, failure of any Control System component, open circuit/short circuit. On any of these failures the controlled equipment/parameter shall either remain in last position before failure or shall come to fully open/close or on/off state as required for the safety of plant/personnel/equipment and as finalized during detailed engineering. System shall be designed such that there will be no upset when Power is restored.
 - The Control system shall be designed to operate in non-air conditioned area. However, Contractor shall provide a Package/Split AC of suitable capacity decided by load requirement in SCADA room. All the power supply module, Ethernet switches and network accessories for non-air conditioned area shall be suitable for operating in ambient temperature of 50 Deg. C.
 - The data acquisition shall be through a desktop workstations of latest configuration. Contractor shall provide external communications link/ browser based monitoring option to the developer to access all data acquisition and real time performance monitoring from its corporate office or from anywhere across the globe. Contractors shall provide



all necessary hardware as required for entire setup.

- The SCADA system shall be equipped with industrial grade with hot stand by and RAID-5 hard disk. The capacity of hard disk should be enough to store the plant data for a period of 25 years. The data for the current one and half year span should be store in instantaneous sampling frequency rate (1 min). The data for remaining years shall be stored at an average of 15 min block thereafter.
- Provision of generating alarm/ error code based on equipment status, failure of equipment, nuisance tripping to be provided. There shall be configurable thresholds values for key parameter such as low current in specific strings or across plant for evaluating the performance.
- Provision for presenting key plant characteristics and historic data in terms of graphs and reports, real time trends shall be provided.
- Monitoring system shall be designed with different dashboards for various users such as Plant O&M team, senior management. The data shall be compatible and transferable to MS Office excel. The source of power for SCADA system and all related hardware shall be from auxiliary power supply. An additional UPS having a minimum 2 hours backup shall be provided dedicatedly for this system.
- Contractor has to provide minimum 2 nos. of concurrent web client license for remote monitoring.
- The SCADA system should have time synchronization GPS clock to ensure there are no discrepancies.

Programmable Logic Based Control System At MCR:

Contractor has to provide PLC based SCADA at MCR room as per specification given hereunder. Other requirement related to PLC mentioned elsewhere in this chapter is applicable for PLC to be provided in MCR. For other locations such ICR Room, PLC/ IO modules/RTUs are acceptable.

PLC Processor

The processor unit shall be capable of executing the following functions:

- a) Receiving binary and analog signals from the field and providing command output to Switchgear / Inverter etc. through Input / Output modules and operator initiated commands from HMIS / control panel.
- b) Implementing all logic functions for control, protection and annunciation of the equipment and systems.
- c) Providing supervisory information for alarm, various types of displays, status information, trending, historical storage of data etc.
- d) Performing self-monitoring and diagnostic functions

PLC unit shall be provided with two processors (Main processing unit and memories) one for normal operation and one as hot standby. In case of failure of working processor, there shall be an appropriate alarm and simultaneously the hot standby processor shall take over the complete plant operation automatically. The transfer from main processor to standby processor shall be totally bump less and shall not cause any plant disturbance whatsoever. In the event of both processors failing, the system shall revert to fail safe mode. It shall be possible to keep any the processors as master and other as standby. The standby processor shall be updated in line with the changes made in working processor.

Priority of different commands shall be as follows:

Manual intervention shall be possible at any stage of operation. Protection commands shall have priority over manual commands and manual commands shall prevail over auto commands.



A forcing facility shall be provided for changing the states of inputs and outputs, timers and flags to facilitate fault finding and other testing requirements. It shall be possible to display the signal flow during operation of the program.

Human Machine Interface System (HMIS)

HMIS configured around latest state-of-the art servers/Workstations with open architecture supporting OPC /TCP/IP protocols, etc. All data should be accessible through this OPC server. For communicating the generation data of solar plant of OA, the SCADA system shall be interfaced/ connected with PI server of OA on OPC Protocol. The details of PI server shall be furnished during the detailed engineering.

Graphical Interface Unit (GIU) / Operator workstation (OWS) shall perform control, monitoring and operation of all devices interacting with PLC based control system. Contractor shall provide engineering workstation (EWS) as programming station of the PLC and SCADA. It shall be possible to use same EWS as programming station and the Human Machine Interface System. SCADA System shall be provided with redundant OWS. Operator shall be able to access all control/information related data under all operating conditions including a single processor and computer failure/ hardware failure at MCR in the HMIS.

The SCADA System shall have ability to perform operator functions for each OWS / GIU as a minimum, include Control System operation (A/M selection, raise/lower, set point/bias change, on/off, open/close operation, mode/device selection, bypassing criteria, sequence auto, start/stop selection, drive auto selection, local-remote/other multi-position selection etc.); alarm acknowledge; call all kind of displays, logs, summaries, calculation results, etc.; printing of logs & reports; retrieval of historical data; and any other functions required for smooth operation, control & management of information as finalized during detailed engineering.

The display selection process shall be optimized so that the desired display can be selected with the minimum no. of operations. Navigation from one display to any other should be possible efficiently through paging soft keys as well as through targets defined on the displays. There should be no limitation on number of such targets.

The system shall have built-in safety features that will allow/disallow certain functions and entry fields within a function to be under password control to protect against inadvertent and unauthorized use of these functions. Assignment of allowable functions and entry fields shall be on the basis of user profile. The system security shall contain various user levels with specific rights as finalized by the Employer during detailed engineering. However, no. of user levels, no. of users in a level and rights for each level shall be changeable by the programmer (Administrator).

One 55 Inch LED display shall be provided at SCADA Room. Remote monitoring of essential parameters on the World Wide Web using standard modem and Popular Browser such Chrome/Internet Explorer shall be provided by the vendor. (Internet connection for transferring data to web shall be taken by Contractor in the name of OA Site for O & M period).

Contractor has to provide suitable hardware firewall to provide network security. In case any specific regulations are issued by competent authority, contractor shall ensure compliance with the same.

All the available parameters of Plant Shall be shown on HMI Individual screen and will be approved at the time of detail engineering.

SCADA shall have facility to provide real time reporting of alarms and statistical data through SMS and e-mails.

Programming Functionalities

Programming of the PLC Processor/controller as well as programming of HMIS shall be user friendly with graphical user interface and shall not require knowledge of any specialized



language. For example, the programming of PLC shall use either of the following:

- Flow-chart or block logic representing the instructions graphically
- Ladder diagrams

The programming of HMIS (like development and modification of data base, mimics, logs / reports, HSR functionalities etc.) shall also be possible through user-friendly menus etc.

All programming functionalities shall be password protected to avoid unauthorized modification.

Software Requirement

All necessary software required for implementation of control logic, operator station displays / logs, storage & retrieval and other functional requirement shall be provided. The programs shall include high level languages as far as possible. The Contractor shall provide sufficient documentation and program listing so that it is possible for the Employer to carry out modification at a later date.

The Contractor shall provide all software required by the system for meeting the intent and functional/parametric requirements of the specification.

Industry standard operating system like WINDOWS (latest version) etc. to ensure openness and connectivity with other system in industry.

SCADA system shall include the following standard protocols as a minimum.

- a) Modbus (TCP/IP, RS485)
- b) Sub Station Protocol (IEC-61850 and IEC 60870 -5-101/104)

Any other protocol on which the offered equipment (by Contractor) will communicate with SCADA

The Contractor shall provide software locks and passwords to Employer's engineers at site for all operating & application software so that Employer's engineers can take backup of these software and are able to do modifications at site.

Parametric Requirements

The control system shall be designed such that under worst case loading conditions the response time shall not be worse than the following:

On/Off Command	-	The response time for screen update after the execution of the control command from the time the command is issued shall be one second (Excluding the drive actuation time).
Adjustment Command	-	0.5 to 1 second.
On screen Updating	-	1 second.
All Control related displays	-	1 second.
Bar Chart displays	-	1 to 2 seconds.
Plant Mimic displays	-	1 to 2 seconds.
Group review displays	-	1 to 2 seconds.
X-T Plot Displays	-	1 to 2 seconds.
Plant Summary Displays	-	1 to 2 seconds.

All the Analog data shall be scanned at the resolution of 1(one) second and refreshed on screen however, recording of data shall be as finalised during detail engineering.

Input/ Output Modules

The PLC system should be designed according to the location of the input/output cabinets as specified. Input Output modules as required in the Control System for all type of field input signals (4-20 mA, non-changeover/change over type of contact inputs etc.) and outputs from



the control system (non change over/change over type of contact, output signals for energizing interface relays at suitable DC voltage as decided during detail engineering, 4-20 mA output etc.) are to be provided by the Contractor. Electrical isolation of 1.5kV with optical couplers between the plant input/output and controller shall be provided on the I/O cards.

The isolation shall ensure that any inadvertent voltage or voltage spikes (as may be encountered in a plant of this nature) shall not damage or mal-operate the internal processing equipment. The Input/output system shall facilitate modular expansion in fixed stages. The individual input/output cards shall incorporate indications on the module front panels for displaying individual signal status.

Individually fused output circuits with the blower fuse indicator shall be provided. All input/output points shall be provided with status indicator. Input circuits shall be provided with fuses preferably for each input, alternatively suitable combination of inputs shall be done and provided with fuses such that for any fault, fuse failure shall affect the particular drive/equipment system only without affecting other systems.

Binary Output modules shall be rated to switch ON/OFF coupling relays of approx. 3 VA. Analog output modules shall be able to drive a load impedance of 500 Ohms minimum.

Output module shall be capable of switching ON/OFF inductive loads like solenoid valves, auxiliary relays etc. without any extra hardware. All input field interrogation voltage shall be finalized during detail engineering in case of loss of I/O communication link with the main processing unit, the I/O shall be able to go to predetermined fail safe mode (to be finalized during detailed engineering) with proper annunciation.

The single (i.e. non-redundant) binary & analog signal required for control purposes shall be wired as follows: All single analog & binary inputs including the limit switches of SWGR check-backs of all drives & information related signals shall be wired to single (i.e. non-redundant) input modules. Inputs and Outputs related to each of the redundant drives / equipment shall be wired to separate input and output modules.

Requirement of Nos. of channel in each type of Module (Analog Input, Analog Output, Binary Input, Binary Output, RTD) and Modbus link at Inverter and main control room shall be calculated based on the Input/output signal list to be submitted by the Contractor for approval during detail engineering.

Historical Storage And Retrieval System (HSRS)

The HSRS shall collect, store and process system data from data base. The data shall be saved online on hard disk and automatically transferred to erasable long term storage media once in every 30 Days periodically for long term storage. Provision shall be made to notify the operator when hard disk is certain percentage full. The disk capacity shall be sufficient to store at least seven days data.

The data to be stored in the above system shall include alarm and event list, periodic plant data, selected logs/reports. The data/information to be stored & frequency of storage and retrieval shall be as finalised during detailed engineering. The system shall provide user-friendly operator functions to retrieve the data from historical storage. It shall be possible to retrieve the selected data on OWS or printer in form of trend/report by specifying date, time & period. Further, suitable index files/directories shall also be provided to facilitate the same.

The logs/reports for at least last thirty (30) days shall be available on the disk. In addition to above, the system shall also have facility to store & retrieve important plant data for a very long duration (plant life) on portable long term storage media). These data will include any data from the database as well as processed/computed data based a various calculations/transformation.

The retrieved data from long term storage media should be possible to be presented in form of alarms, logs, reports, etc.



SCADA shall have facility to store long term data, days wise/ weekly/ monthly/yearly for 25 years for analysis and analytical reports to analyse the plant performance (PR) at various levels i.e. SMB, Inverter, Plant. For faster retrieval of long term aforementioned performance data, Contractor shall offer time series data historian of 200 tags minimum for plant capacity up to 20 MW, however actual nos. of tags shall be determined based on the tag calculation.

Following plant performance (PR) long term data as a minimum with time stamping and interval as indicated in below table but not limited to shall be stored daily on historian for analysis and analytic report.

Important plant data for a very long duration (plant life) Storage

Parameter	Time Interval
Weather Monitoring Stations data: Global Horizontal Irradiance, Global Inclined Irradiance and Diffuse Horizontal Irradiance, Ambient Temp, Wind Speed, Wind Direction, Rain Fall and Relative Humidity.	1 (One) Second with adequate storage and capability in data loggers
Calculated Daily Global Horizontal Insolation, Global Inclined Insolation and Diffuse Horizontal Insolation.	24 (Twenty Four) Hours
Power Conditioning Unit (Inverters): DC Voltage, DC Power, DC Current, SMB/SMU Current (Inverter end), AC Active & Reactive Power, Power factor, AC Current & Voltage, Energy, Inverter room temp, Inverter Cabinet temp and Modules Temp	1 (One) Minute
MFM, Energy meter and Numerical Relay data: Active & Reactive Power, Energy (day), Current and Voltage	1 (One) Minute
Export feeder/s Energy Meter Data: Active & Reactive Power, Energy import and export, Current and Voltage and Grid Frequency.	1 (One) Minute
Daily energy export from each Inverter	24 (Twenty Four) Hours
Total sum of daily energy export from all Inverter	24 (Twenty Four) Hours

Separate/stands alone historian server as per specification mentioned in respective clause.

Control Cabinets / Panels / Desks At MCR Room

The cabinets shall be IP-4X protection class. The Contractor shall ensure that the packaging density of equipment in these cabinets is not excessive and abnormal temperature rise, above the cabinet temperature during normal operation or air-conditioning failure, is prevented by careful design. This shall be demonstrated to the Employer during the factory testing of the system. The Contractor shall ensure that the temperature rise is limited to 10 deg. C above ambient and is well within the safe limits for system components even under the worst condition and specification requirements for remote I/O cabinets. Ventilation fan shall be furnished as required by the equipment design and shall be sound proof to the maximum feasible extent. If fans are required for satisfactory system operation, dual fans with fan failure alarm shall be provided in each cabinet with proper enclosure and details shall be furnished with proposal. Suitable louvers with wire mesh shall be provided on the cabinet. The cabinets shall be designed for front access to system modules and rear access to wiring and shall be designed for bottom

entry of the cables for Main control room.

The cabinets shall be totally enclosed, free standing type and shall be constructed with minimum



2 mm thick steel plate frame and 1.6 mm thick CRCA steel sheet or as per supplier's standard practice for similar applications, preferred height of the cabinet shall not higher than 2200 mm. The cabinets shall be equipped with full height front and rear doors.

The floor mounting arrangement for other cabinets shall be as required by the Employer and shall be furnished by the Contractor during detailed engineering. Wall mounted cabinet is acceptable for Inverter room/sub pooling switchgear. Cabinet doors shall be hinged and shall have turned back edges and additional bracing where required ensuring rigidity. Hinges shall be of concealed type. Door latches shall be of three-point type to assure tight closing. Detachable lifting eyes or angles shall be furnished at the top of each separately shipped section and all necessary provisions shall be made to facilitate handling without damage. Front and rear doors shall be provided with locking arrangements with a master key for all cabinets. If width of a cabinet is more than 800 mm, double doors shall be provided.

Control Desk

Control desk shall be free standing table top type with doors at the back and shall be constructed of 2 mm thick CRCA steel plates. A 19 mm thick wooden top shall be provided on the desk to keep the TFT monitors at top and computers inside. Control desk shall consist of vertical, horizontal and base supports with their coverings for work surface, keyboard trays, mouse pads, monitor shelf and concealed cable and wire way management, perforated trays with covers in both horizontal and vertical directions. Telephone sets, very few PB stations and lamps shall be mounted on the control desk on mosaic grid structure and same shall be decided during detailed engineering. ASCII Keyboard shall be capable of being pulled out through a tray.

Each Control Desk shall have two UPS input power supply and one raw power supply. It shall be ensured that Workstation remain in service in case of single UPS power supply failure.

The cabling / wiring between OWS & CPU'S, power supply cables etc. shall be aesthetically routed and concealed from view.

Furniture

Chairs – Industry standard revolving chairs with wheels and with provision for adjustment of height (hydraulically/gas lift) shall be provided for the operators, unit-in-charge & other personnel in control room area (At least 6 Nos). One Printer Table made of Laminated Wood or Heavy Duty MDF shall be provided for printer. All the furniture shall be of reputed make only. Client may suggest the same during detailed engineering.

Software Documentation And Software Listings

All technical manuals, reference manuals, user's guide etc., in English required for modification/editing/addition/deletion of features in the software of the PLC System shall be furnished. The Contractor shall furnish a comprehensive list of all system/application software documentation after system organization for Employer's review and approval. All The software listings for application software, Project data files etc. shall be submitted by the Contractor.

All the SCADA Software with license Key shall be handed over to OA on the DVD/ CD media. All the hardware and software shall be licensed to OA.

Software Licenses

The Contractor shall provide software license for all software being used in Contractor's System. The software licenses shall be provided for the project (e.g., organization or site license) and shall not be hardware/machine-specific. That is, if any hardware/machine is upgraded or changed, the same license shall hold good and it shall not be necessary for Employer to seek a new license/renew license due to up gradation/change of hardware/machine in Contractor's System at site. All licenses shall be valid for the continuous service life of the plant. User ID and password for remote view can only be changed by SCADA Administrator.

Time Synchronization



The Contractor will provide at least one GPS clock, which shall be synchronized with the SCADA system and all devices which are communicating with Solar SCADA shall be synchronized with GPS Clock through SCADA or directly with GPS Clock.

EWS And OWS Specification

The plant shall have **EWS** (1 Nos) with standard specifications. The server to be chosen with RAID 5 configuration, redundant power supply and dual Ethernet for isolating the plant network from the internet. Server grade engineering workstation shall have below minimum specification:

- RAID controller
- Configuration: RAID 5
- Form factor: Tower
- TB Hot Plug Hard drives 7.2K: 2 Nos (or as required inline with specification)
- GB Memory upgradable to 32 GB
- Intel(R) Xenon (R) Processor 3.3 GHz, 64Bit OR Latest configuration.
- Graphics card 2GB External
- Dual Network cards
- Dual Hot plug, redundant power supply
- DVD R/W 16 X or higher
- 40" LED Display
- Windows server Latest version, MS Office, Adobe Acrobat, Anti-virus, etc.

Plant shall have own **OWS** (1 Nos) with Intel Core i7-64Bit Processor, 1TB Hard Drives: 1No, RAM 8 GB Memory, Keyboard & Mouse, DVD R/W, 22" LED display, Windows OS Latest Version, MS Office, Anti-Virus.

Following is the recommended specifications for RS485 & IO Cables.

- **For Outdoor RS485:** 2C X 2P X 0.5sq.mm, ATC multi-strand (class 5), insulated core, two twisted pair, overall screened with ATC drain wire, GI round wire Armored, PVC sheathed, DIN47100 color, standard, FRLS cable.
- **For Indoor RS485:** 2C X 2P X 0.5sq.mm ATC multi-strand (class 5), insulated core, two twisted pair, overall screened with ATC drain wire, shielded, PVC sheathed, DIN47100 color standard, FRLS cable.
- **For IO cabling (between HT/RMU panels and SCADA panel):** 1 sq.mm multi-strand, 2/12/24 core screened flexible, FRLS cable.
- **For Optical Cabling:** 8F, Armored, Single or Multi-Mode as per requirement.

Communication Cable

Optic Fiber cable shall be 6/8/12 core, galvanized corrugated steel taped armored, fully water blocked with dielectric central member for outdoor/indoor application so as to prevent any physical damage. The cable shall have multiple single-mode or multimode fibers on as required basis so as to avoid the usage of any repeaters. The core and cladding diameter shall be 9 +/- 1 micrometer and 125 +/- 1 micrometer respectively.

The outer sheath shall have Flame Retardant, UV resistant properties and are to be identified with the manufacturer 's name, year of manufacturing, progressive automatic sequential on-line marking of length in meters at every meter on outer sheath.

The cable core shall have suitable characteristics and strengthening for prevention of damage during pulling viz. Steel central number, Loose buffer tube design, 4 fibers per buffer tube (minimum), Interstices and buffer tubes duly filled with Thixotropic jelly etc. The cable shall be suitable for maximum tensile force of 2000 N during installation, and once installed, a tensile force of 1000 N minimum. The compressive strength of cable shall be 3000 N minimum & crush



resistance 4000 N minimum. The operating temperature shall be -20 deg. C to 70 deg. C.

- All testing of the optic fiber cable being supplied shall be as per the relevant IEC, OES, and other international standards.
- Cables shall be suitable for laying in conduits, ducts, RCC trenches and racks installation.
- Spliced/ Repaired cables are not acceptable.
- Penetration of water resistance and impact resistance shall be as per IEC standard.

Operation & Maintenance Tracking

Power evacuation utility metering may also be required to be integrated in SCADA system. Contractors to investigate further on this requirement from evacuation utility. The SCADA system should have an asset management section where the status of the spares, health of the equipment can be tracked down. Robotic cleaning systems shall be synced with SCADA and must operate in tandem with Soiling station outputs.

Fire Detection And Fighting

The solar PV plant shall be equipped with suitable fire protection, detection and fighting systems for entire PV array area, all inverter room and main control room and switchyard as per the fire safety standards and local fire authority requirements. Firefighting of transformers and other electrical equipment as required shall be in accordance to tariff advisory committee & OES Standards.

Fire Extinguishers: Portable type fire extinguishers conforming IEC Standards shall be provided as means of dealing effectively and immediately with fire caused from oils, solvents, gases, paints, varnishes, electrical wiring and all flammable liquids and gases. System shall comply with required insurance norms. Following type of portable fire extinguishers shall be provided in modular plot control rooms and main control room.

- DCP type fire extinguisher 10 kg capacity.
- CO2 operated hand portable extinguisher 9 kg Capacity.
- Foam type hand portable extinguisher 9 kg capacity.

Additionally, CO2 operated, trolley mounted fire extinguishers having a minimum jet range of 8m shall be provided. These shall be placed in the main control room. All the fire extinguisher shall be subjected to anticorrosive treatment and shall be painted and marked as per requirement of relevant standards.

Fire buckets: Fire buckets shall be provided in all modular unit control rooms and transformer yards with fine sand and fixed on an angle iron frame as per requirement of local authorities. Fire buckets shall be painted red with additional handle at the bottom and a cover to avoid moistening of sand.

Addressable type Automatic fire detection and alarm system shall be provided in and main control room and SCADA Room. Fire detection and alarm system shall be integrated with required cabling to a single fire alarm control panel. Fire detection alarm system shall include alarm initiating multi sensor type smoke detectors. The entire system shall work on auxiliary power supply. In case of power failure, the complete system shall function in normal condition on maintenance free back-up batteries. Manual call points and hooters shall be provided for all the modular plot control rooms. These shall be further integrated with fire alarm control panel in main control room.

Technical Specifications

Multi Detector Sensor

Operating Voltage : 8.5 VDC to 33 VDC

Current consumption < 0.12 mA

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Protection Category	:	IP 40
Permissible operating temperature	:	-20 °C to +50 °C
Monitoring area	:	max 40 Sqm.
Maximum installation height	:	6 m
Alarm resistance	:	Max. 820 Ω
Manual Call point		
Range of use	:	Indoor
Mounting	:	Surface/Flush mounted
Operating voltage	:	16.2 VDC to 30 VDC
Protection category	:	IP 54
Permissible operating temperature	:	-10 °C to +55 °C
Hooter		
Operating Voltage	:	9-30 VDC
Max. Current	:	36 mA
Consumption	:	
Monitoring	:	Reverse Polarity
Protection Category	:	IP 54
Fire Panel		
Detector Zone:	:	Min. 2
Max. number of detectors:	:	64
Max. number of detectors per zone:	:	32
Input Voltage:	:	230 VAC +10%/-15%, 50-60 Hz
Max. Current	:	375 mA
Consumption	:	
Power Consumption	:	80 W
Makes - As per Annexure- A		



Civil & Structural Systems

Site Preparation

The site preparation shall include all the work as required for installation of a utility scale solar PV plant as per the standard industry practices. Required leveling shall be carried out by the Selected Bidder based on the assessment of probable grading required. The Selected Bidder, upon requirement shall have to carry out the following works:

- Land cleaning and removal of shrubs
- Land development, grading, leveling or filling as needed o Construction of drains, culverts as per the requirement

Site Facilities

- The Bidder shall provide all Site facilities, including all utilities and sanitary facilities for its use within and outside the project site premises. The Bidder shall provide adequate temporary sanitation facilities for its employees and labors to maintain hygiene onsite.
- Storage for material/ inventory supplied at the site shall be in the Bidder's scope. The respective Supplier standards, recommendations and practices shall be followed for open storage and covered storage for all the equipment.
- Appropriate housekeeping shall be provided by the Bidder to timely replenish the material breakage/ theft/ repair including transport without cost to the clients.
- Bidder shall arrange construction water and construction power at own cost. Any cost incurred for construction water and electricity required during the civil works, erection, installation, and/or commissioning shall be in the scope of bidder.

Roads and Pathways

Suitable approach road and internal Solar Photovoltaic roads to carry safe and easy transportation of equipment and material at the project site shall be made. The road should provide easy and fast approach to each location of the plant. These roads are to be designed optimally to carry the crane load with all necessary chambers, gradients, super elevation, and radius of curvatures for the easy movement of cranes, trucks and public transport. All Roads are to be constructed with sufficient width (minimum 3.5 m) followed by 0.5m well compacted shoulders on each side. The road must be well compacted as per the AASHTO.

The bidder shall be responsible for the complete transport of the plant equipment to the Site. The bidder is free to design the transportation concept considering, but not limited to, the physical limitations and permitting restrictions on the roads in Oman. The bidder shall take into consideration the loading capacities and clearances of existing bridges and connecting roads when carrying out transportation from the ports or from other places to the Site and vice-versa. Internal roads within the Site shall be the responsibility of the bidder. Internal roads shall be planned and constructed according to the plant configuration proposed by the bidder and shall be adequate and suitable for the operation and maintenance stage.

The bidder shall submit a draft layout of the internal road and platform system as well as of the access road with the necessary specifications being adequate for the transport and erection of the offered pieces of. In addition, the bidder shall guarantee that this layout and the given specifications are suitable for the erection and operation of the Plant.

MMS Super Structure Specification

The Supplier/Contractor's scope of supply shall include, manufacturing, testing, inspection, packing, forwarding, delivery and Installation of MMS shall be at project site location in accordance to the procedure agreed between the Owner and the Manufacturer. Supplier shall also provide 25-year product warranty against defects.



Table below indicates a non-exhaustive list of standards to which all the mounting structures shall conform.

Applicable standards for Module mounting structures	
AISI Manual	Cold-Formed Steel Design
ASCE 7-16	Minimum design loads for building and other structures
AISC 360	Specifications for Structural Steel Buildings.
AISC 341	Seismic Provisions for Structural Steel Buildings.
ASTM A6	General Requirements for Rolled Steel Plates, Shapes, Sheet Piling and Bars for Structural Use.
ASTM A36	Structural Steel.
ASTM A53	Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A123	Zinc (Hot-Dip Galvanized) Coatings on Products Fabricated from Rolled, Pressed and Forged Steel Shapes, Plates, Bars and Strip.
ASTM A325	High-Strength Bolts for Structural Steel Joints.
ASTM A441	High-Strength, Low-Alloy Structural Manganese-Vanadium Steel.
ASTM A500	Grade B Cold-Formed Welded and Seamless Carbon Steel Structural Tubing.
A653A653M-15_Stand	Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
AWS A2.4	Welding Symbols.
BS 1449:	Structural steel sections
BS 2994:	Specification for cold rolled steel sections
BS 5950-5:1998	Structural use of steelwork in building - Part 5. Code of practice for design of cold formed thin gauge sections
BS 5531:	Safety in erecting structural frames
BS 5950	Structural use of steelwork in buildings
BS EN 10056:	Structural steel equal and unequal leg angles
BS EN 10147:	Continuously hot-dip zinc coated plate and strip
BS EN 10155	Structural steels with improved atmospheric corrosion resistance. Technical delivery conditions
BS EN 197 :2000:	Cement. Composition, specifications and conformity criteria for common cements
BS EN 480:	Admixtures for concrete, mortar and grout. Test methods.
BS EN 934	Admixtures for concrete, mortar and grout. Concrete admixtures
BS EN 1008 :2002	Mixing water for concrete. Specification for sampling, testing and assessing the suitability of water, including water recovered from processes



Applicable standards for Module mounting structures	
	concrete industry, as mixing water for concrete
BS EN 1011:	Welding. Recommendations for welding of metallic materials
BS EN 10238 :1997	Automatically blast cleaned and automatically primed structural steel products
BS EN 12620:	Aggregates for concrete
BS 12:	Specification for Portland cement**
BS146 :2002	Specification for blast furnace cements with strength properties outside the scope of BS EN 197-1
BS1305	Specification for batch type concrete mixers*
BS1370: 1979	Specification for low heat Portland cement
BS1881	Testing concrete
BS3963 : 1974	Method for testing the mixing performance of concrete mixers*
BS7079	Preparation of steel substrates before application of paints and related products
BS5328 :1981	Methods for specifying concrete, including ready-mixed concrete
BS8008: 1996	Safety precautions and procedures for the construction and descent of machine-bored shafts for piling and other purposes
BS5930 :1999	Code of Practice for site investigations
BS8004 :1986	Code of Practice for foundations
BS8110:	Structural use of concrete
BS 1722-1	Specification for chain link fences
ASHTO	Design of pavement structure

Mounting structures shall comply with the following:

- Mounting structures shall use module manufacturer recommended installation accessories like mounting clips, rails, racks etc. The design shall be approved by the module manufacturer prior to fabrication in case applicable. Any such approval shall be submitted to the client.
- No on-site fabrication will be permitted; all the structure members shall be factory fabricated and only assembled on site.
- Supplier shall provide module mounting structure design in compliance with relevant applicable standards and shall analyze the structure in 3D staad.pro software. Manual design calculation for all cold formed sections and fasteners used in mounting structure shall also be provided in addition.
- The mounting structures should be checked for stability with minimum deflection and sagging. Maximum permissible limit for sagging shall in compliance to L/200 for the beams spanning between two or continuous supports, L/180 for purlin overhang and L/300 for the columns and / or module manufacturer's installation guideline, suitable bracings shall be provided for strengthening of all structural members.
- Min. Ground Clearance of module should be 500 mm and min. pile copping shall be 150mm.

• Key Design Considerations



Member	Material Type	Grade	CoatingThk. Min.	Material Thk.(Min)	Remark
Column	HDG	S355	85μ	2 mm	- Column at center of rafter and Eccentric column design is allowed. -Column extension piece is not allowed.
Rafter	Galvalume/ Posmac	Fy 550	AZ 185 / ZAM 300	1.2mm	
Purlin	Galvalume/ Posmac	Fy 550	AZ 185 / ZAM 300	1.2mm	
Bracing	Galvalume/ Posmac	Fy 550	AZ 185 / ZAM 300	1.6mm	-Joints in the bracings are not allowed.
Child Parts	HDG	S355	Min. 85μ	2mm	

- Wind speed of the project shall be considered minimum 160 kmph for 3 seconds or local municipality guidelines, (whichever is higher) to be considered, and on the basis of historical data of project location. All fasteners for module mounting shall be SS 316. Supplier will provide GA drawings, design calculation along with STAAD input & output (.std file), shop drawing (.dwg file), bill of Material before getting approval on these documents.
- The MMS materials processed out of cold form sheets may require to be treated for corrosion (Galvalume / HDG). This treatment shall essentially be suitable for a minimum of 1200 hours of salt spray test without any effect of corrosion. Independent test results of salt spray tests may be submitted by Suppliers when required.
- Module manufacturer approved PV module fixing clamps shall be used for the project. Only Stainless-steel fasteners shall be used for these clamps. Mounting structures shall be designed to facilitate easy replacement of solar PV modules.
- Structure shall have provision to connect the earth cable joining one structure to the other. Connecting modules and structure to same ground cable.
- Structure design shall include a method of fastening the DC cables to the structure at every 500mm without causing tearing or fluttering of cables.
- Contactor shall carry out proto inspection with load tests for complete structure assembly including fasteners & modules etc. The MMS structural behavior (or observed deflections) for the dead loads shall be as calculated/observed during analysis of structure in software (STAAD); if not, then the prototype test will be called as "failed" and then, the analysis and design of the structure shall be rechecked. If we observe any correction to be done in proto type; Supplier shall carry out all the correction / modification of structure at their own cost.
- Option for MMS foundation along with design calculations, detailed drawings, STAAD report and BOM need to be submitted for customer approval.
- Detailed Specification of various raw material meant for MMS and Civil work has to be provided as per relevant Standards and National building codes.
- Structure to be designed for required loading, wind load of the zone and considering all safety factors in accordance to Standard, for trouble free life expectancy of 25+ year.
- Module mounting fixtures shall also comply to module manufacturer recommendations



and shall be approved by the module manufacturer. BIDDER to demonstrate proper earthing of modules by ensuring proper contact between fastener and module frame.

- No increase in allowable stress values over the permissible values shall be allowed for members.
- Surfaces which are uncoated in HDG members like at edges shall be corrected by zinc – rich paint (after cleaning and removal of mill scale. Normally minimum 90% m/m metallic zinc content of dry film).
- All the punched location of pre-galvanized sheet after fabrication shall be sprayed with Zinc-Aluminum spray at factory work itself.

Mounting Foundation

- Mounting structure foundation shall be designed for actual soil conditions as per soil report or for the worst case as envisaged in the soil report. Mounting structure foundation shall be designed as per BS8004 :1986. System shall be made in such a way that it should transfer loads safely to the soil, depending on soil conditions, geographical condition, regional wind speed, bearing capacity, slope stability and dead load of system etc.
- MMS foundations and its depth shall be decided based on the approved geotechnical investigation report and the pile load test. No foundation will be allowed to construct on non-compacted back filled soil and the foundation depth to reach up to NGL.
- All loads including the Seismic loads for design shall be in accordance with the relevant Standards / clauses of the Standards.
- All RCC works shall be design mix as per relevant Standards, for structural concrete items ordinary Portland cement 43 Grade, and type of cement for sub- structures shall be decided based on the final Soil Investigation report. Every foundation shall be provided with a minimum of 150 mm concrete pedestal for direct water contact with structural steel posts.
- MMS Foundation pile cap shall be increased by the same amount the column height above ground level is increased to counter undulations.
- Lateral capacity for pile foundation shall be calculated by Broms method and minimum factor of safety for all pile capacities shall be 2.5.

Inter-row Space for Module Mounting Structures Cleaning

In addition to optimizing the inter-row pitch for minimum shading, adequate inter-row spacing shall be maintained for cleaning of modules. Cleaning strategy for the plant shall be using a Robotic Cleaning Solution (fully/semi automatic as validated during detailed engineering) Back-up provision for manual wet cleaning with a tanker and flexible hose (UV protected) to be used in between the rows and adequate space shall be maintained to support the same.

Plant Boundary Fences

The objective to provide a Chain-link fencing is to demarcate the boundary and to keep away the unauthorized access to plant. The contractor shall provide GI chain I all around the periphery of the plant. In addition, two rows of barbed wire as an anti-climb guard will be mounted on top of the fence. The security concept must be in line with the National Standards. The wall height must be minimum of 2.5m from NGL. Specification of chain link fencing shall be as per BS 1722.

1. Concrete posts and struts shall be of steel reinforced concrete conforming to BS EN 12839 and Annex A. Concrete post min section dimensions shall be 125x125mm. Minn dia. Of chain link fencing shall be 3mm and min diamond size 50x50mm. Min width of the gate shall be 6m.

Plant Lighting System



Lighting system for maintenance purpose shall be provided at Inverter Control Room (ICR). Utmost care should be taken for avoiding any shading effect due to the poles. The light fittings shall be highly efficient LED lights having longer life.

Normal AC Lighting System: AC lighting system 415V, 3Phase, 4wire, will be fed from ACDB panel, which is connected with secondary of auxiliary transformer of suitable size.

Emergency AC Lighting System: The emergency lighting system consisting of 20% of the lights shall be fed from UPS DB as per scheme adopted by the bidder. Load of the same has to be considered for UPS/ Battery and charger sizing.

An average 300 lux at 1 meter above floor level for the Inverter Control Room (ICR) and Main Control Room shall be maintained.

An average 30 lux for street lighting at road surface level shall be maintained.

An average 100 lux at 1 meter above floor level should be maintained in security cabin.

The connecting wires used inside the system shall be FRLSH type and fuse / CB protection should be provided at the input side for LV luminaries. LED drivers should have suitable precision current control O/C, S/C, over temperature, overload protection and can be timer programmed.

Water Supply System

The solar PV plant shall have an independent based underground water tank with a minimum capacity of 10000 liters. The required water during construction and during O&M period shall be sourced by the Bidder. The water supply system shall be complete with adequately sized electrical pumps. Water supply system shall include all the pipes, valves and plumbing works as required to complete the system. Bidder to examine availability & suitability of water to meet the requirement for recommendation of module manufacturer, firefighting & general purpose. Bidder has to arrange water piping system using High Density PVC pipes for cleaning of solar modules. This water piping system shall be designed for minimum working pressure by providing suitable pumping system and it should be ensured that each water point should reach to individual module.

Drainage System

The Bidder is expected to study the site topography and area hydrology and plan the surface drains accordingly. A grading plan and drainage plan (taking into consideration the existing drains passing within and nearby the plots) has to be prepared and got approved from the Client. The flow path of water shall be planned in such a way that it is connected to the existing drains in the plots. The grading shall be proposed in such a way that the cut and fill volumes nearly match. Drain channels of sufficient size have to be planned for safe discharge of surface water up to the existing drainage system. Drain shall be dry stone pitched earthen drains with PCC at the base. The last portion of the drains leading to existing drainage system. The extent of pitching of drains shall be such a way that there is no scouring due to accumulated flows. Drain Cross section should be as per design, with a minimum depth of 500mm.

For rain fall assumptions, data for past 50 years may be referred from the nearest metrological station, and may be considered for 10 years return period. While planning drainage, outside catchment, which have influence on the project area, may also be studied and considered and accordingly the diversion of the external flows has to be planned.

Rain water harvesting ponds may also be considered as part of the system. Utmost care shall be taken to maintain slopes and to prevent water clogging at the site. Proper water drain channel with RCC Hume pipe culverts shall be designed wherever necessary. All culverts should have RCC/CC abutments and designed as per international standards.

Internal Electrification

Internal electrification as required in the PEB rooms, transformer yard, etc. shall be adequately



provided by the Bidder. The point wiring system shall be rated for a voltage of 1100 Volts three phase or single phase as required. This shall consist of PVC insulated FRLSH wires in GI/MS conduits wherever wiring is on surface / concealed (as per OAMC norms) and in heavy duty rigid PVC conduits wherever wiring is concealed. These wires shall be 1100 V grade, FRLSH, single core multi-strand copper PVC or XLPE insulated.

Primary point wiring be fed from the distribution board and secondary point wiring shall be looping between the first light point/ power point to subsequent lighting points/ power points. Secondary points may also be controlled by a switch. Emergency lighting system shall be provided for certain strategic locations. Distributions boards along with the controlling MCBs, MCCBs and RCCBs shall be suitable for recessed or on surface mounting in wall. Distribution boards shall be made from 16SWG sheet steel within lockable spring loaded cover of appropriate powder coating. The enclosure shall meet IP4X rating for indoor installation. The construction shall be according to Form -2 of IEC. Adequate size cable compartment should be provided for easy clamping of all the incoming and outgoing cables irrespective of top or bottom entries. CBCT with ELR shall be provided at main incomer along with MCCB with LSI protection.

Civil Infrastructure

Control Room

The Inverter Control Room (ICR) and Main Control Room (MCR) shall comprise of building housing Low voltage AC switchgear, 11 kV HV switchgear, UPS, battery bank, battery charger SCADA Panel, Aux transformer and ACDB etc. and 11kV transformers as required for a plot.

- All RCC works shall be design BS 8110-1-1997. The foundation system shall be made which transfer loads safely to the soil for the module mounting structures, depending on soil conditions, geographical condition, regional wind speed, bearing capacity, slope stability etc. All foundation system and foundation depth shall be decided based on the approved geotechnical investigation report. No foundation allowed on back filled soil and the foundation depth to reach upto NGL. All loads shall be considered in line with BS 6399-1 to 3. Seismic loads for design shall be in accordance with UBC 1997 and relevant Standards. Check all vertical and horizontal deflection checks shall be performed by using maximum allowable deflections as per standards. The lateral supporting system consists of columns that transferring the lateral loads to the foundations. Building shall be designed as per standard specifications and ensure the life of structure for a period of not less than 25 years.
- The rooms shall have provision for openings for air conditioner, inverter ventilation/ exhaust, piping and cabling on wall in accordance to design requirement.
- Applicable Local Building Standards (OES/Municipality) should to be followed.
- The floor of the building shall be designed to accommodate Low voltage AC switchgear, 11 KV HV switchgear, UPS, battery bank, SCADA Panel, Aux transformer and ACDB, incoming and outgoing cables in trenches, 6mm thick painted MS chequered plates etc. The floor of the building shall be epoxy/polished concrete floored with suitable approved Colour. Suitable sized door with climbing steps at one side and a ramp arrangement with manually closable rolling shutter have to be provided in each building.
- The size and layout of the room(s) shall meet the requirements of equipment manufacturer, local statutory requirements, and sufficient setbacks to be maintained from safety and maintenance point of view. The layout of building including dimension details, provision of doors, windows, shutters etc. to be



approved by OAMC before Construction.

- Separate UPS and Battery room with proper ventilation to be provided. Similarly, the LT & HT equipment shall be installed in separate rooms.
- Fire alarm panel, Opto-thermal/smoke detectors and Manual call point and hotter to be provided and the fire alarm system for each building to be integrated with OAMC main fire control room through wireless communication without any additional cost including hardware and software integration.
- The fire alarm system should be centralized in line with the Airport system.
- Civil defense approval required for fire alarm system.
- The contractor should deploy a fire consultant who will develop the drawings according to OMAC standards, which will be approved by civil authority.
- Fire extinguishers and sand buckets as per the requirement to be provided
- Rolling shutter, ramp, windows, ducts for ventilation, door at the exit etc. to be provided.
- Suitable arrangement for all incoming and outgoing cables & earthing strips including proper arrangement for laying of cables & earthing strips inside the building to be provided.
- Any other requirement suitable to meet the manufacturer's recommendations, solar power plant requirements, site requirements and statutory requirements shall be provided without any extra cost.

Fire Alarm, Fire Fighting and Emergency Lighting and security

- All buildings associated services like fire alarm, building management system, IT system, access card system etc. should be interfaced with existing centralized SCADA system of the OAMC.
- Bidder has to appoint a consultant who will design and develop fire alarm, firefighting and emergency lighting layout and take approval on it from Civil Defense department. After that, building can be allowed to use.

Site Restoration

The Bidder shall reinstate all areas, which have been disturbed during the work with landscaping and indigenous seeding, including conformance to the Bidder's best practices and standards in consultation with developers. The intention is to reinstate the existing ground cover wherever possible. Reinstatement shall be in accordance with the developer approvals, planning and environmental constraints on the Work.

PV Module Cleaning

Cleaning of modules directly relates to soiling loss. Bidders shall present with cleaning schedules and assumptions made for soiling loss in energy yield predictions. Bidders shall strictly follow the O&M manual and instructions of PV modules for routine cleaning.

For regular plant Operations and Maintenance, Fully/Semi automatic robotic systems of adequate quantity need to be supplied along with plant. Calculation of number of robots and corresponding soiling loss must be justified during detailed engineering. Compatibility of such robotic supplier with PV module being supplied shall have to be proved by Bidder specifically to avoid any warranty issues with PV Module OEM.

As a back-up or once a quarter, manual wet cleaning shall be done. Water may be supplied through water tankers. Irrespective of source of supply, the Bidder shall route the water to underground water reservoirs. It will be Bidder's scope for construction of water tanks, piping



and pumping as required. Module cleaning should be performed using water quality specified by the module manufacturer. If required, bidders shall provide reverse osmosis/ water softener/ cation resin/ anion resin or combinations in accordance to the source raw water quality to get desired treated quality of water for cleaning the modules.



ANNEXURE A – Approved/Recommended Makes

Bidder to comply with DCRP's most recent available "Active product list" published at the time of procurement (for the items covered in such list)

Components	Approved / Recommended Makes
Module Mounting Structures	Steel / Aluminum mounting structure from reputed manufacturers. Preference will be given to local supply.
Solar Cables	Ducab / OCI / Nuhas / Leoni / Helukabel
MC4 Connectors	Staubli / Bizlink / Amphenol / Pheonix contact
Monitoring System/SCADA	ABB / GE / Schneider / Meteoccontrol / GPM / reputed proprietary and third party
LT Power Cables (up to Inverter)	OCI / Nuhas / DUCAB / National Cable Factory / Federal Cables / National Cables Industry
Weather Monitoring Sensors	Campbell Scientific/ Davis / Aeron / Meteo control / OTT Hydromet Pyranometer – Kipp&Zonen / Hukseflux Weather Stations - Lufft
DC Fuses	Cooper Bussmann / Littelfuse / Mersen
Surge Protection Devices	ABB / Citel / DEHNguard / Pheonix
HT Cables	OCI / Nuhas / DUCAB
Inverter Transformers	Voltamp Transformers Oman SAOC (Dynamic Short circuit Type tested design)
Auxiliary Transformers	Federal Transformers Co. LLC / Emirates TransformSwitchgear LTD / TESAR / EMG Power Electric / Voltamp Transformers Oman SAOC
HT Termination Kits & Straight Through Joints	REPL International Ltd / Yamuna Cables Accessories / Tyco Electronics Raychem / NEXANS Italia SPA
11 kV Switchgear	Al Assar Electric LLC / Voltamp Energy / Jyoti Sohar Switchgear LLC / Al Hassan Power Industries L.L.C / Toshiba TDS Asia SDN / Siemens AG
Protection Relays	GE UK Grid Solutions / ABB OY / Schneider Electric / ABB AB, Sweden / Siemens / SEL Schweitzer / Arecteq Relays Ltd
Auxiliary Relays	Relay Monitoring Systems (RMS) / Siemens / Electrotecnica ARTECHE Smart Grid
Surge Arrestor	ABB Power Grids Switzerland LTD / Cooper Power Systems
Isolators	GR Power / Elektrolite / CGL / Siemens
Insulators	Bin Salim Manufacturing LLC / Electrical Insulator Industries LLC / EB Rebosio SRL / Zhongrui Electric Co., LTD
Battery and battery charger	Power Management Instruments (PMI) / AEG Power Solution / CEG Elettronica Industrial / SPA / APC
CCTV	Samsung / Hikvision / Bosch / Honeywell / Axis Communication
Cable tray and associated hardware as per specification	Gersan Elektrik LLC / Sigma Factory for Steel Products / Everest Metal Industries / Power Solution Industries
Distribution Boards	L&T / Legrand / Schneider / Siemens / ABB
LED Indicating Lamps	Altos / GE Power Control / Schneider / Siemens / Tecnik/ L&T / ABB
PVC Insulated Copper wires for internal electrification	OCI / Nuhas / DUCAB



Earthing Material	Earthing Chamber - Hidrostand SL Earth Rod & Accessories - Citizen metalloy / Speedwell Technologies Pvt. Ltd / Brass Copper & Alloy Ltd / Supreme & Co Pvt. Ltd. / ABB / Kingsmill Industries
CTs / PTs / CVTs	ABB / Siemens / Secure
Electrical Conduits	National Plastic Factory / Muna Noor
Copper Cable Termination Lugs	Pioneer Power International / Brass Copper & Alloy Ltd / Sofamel SA
Danger Plate & Numbering Plate	National Trading Co / International Energy & Investment LLC / Anandsons Overseas Trading Private Limited
Cable Protection Tiles	Abraj Al Buraimi Trad. Co / Golden International Plastic Factory / Kangaroo Plastics Middle East LLC / Al Samir Plastic IND





ANNEXURE B – Acceptance Tests

HT Cables

- Routine Test
- Conductor resistance test
- Partial discharge test
- High voltage test
- Factory Acceptance Test
- Annealing test for copper
- Tensile test for aluminium
- Wrapping test for aluminium
- Conductor resistance test
- Partial discharge test on full drum length
- High voltage test
- Test for thickness of insulation and sheath
- Hot set test for XLPE insulation
- Tensile strength and elongation at break for insulation and outer sheath
- Insulation resistance test (Volume resistivity test)
- Dimensional
- Outer test as per req. according to GTP & any other
- Flammability Test

LT Cable

- Routine Test
- Conductor resistance test (Continuity test)
- High voltage test at room temp
- Partial discharge test

Factory Acceptance Test

- Dimension
- Annealing test for copper
- Tensile test for aluminium
- Wrapping test for aluminium
- Thickness of Insulation and sheath
- Tensile strength and elongation at break for insulation and sheath before ageing
- Hot set test
- Conductor resistance test (Continuity test)
- High voltage test at room temp.
- Hot set test for XLPE insulation
- Insulation resistance test (Volume resistivity)
- Insulation resistance test
- Flammability test
- Embossing on outer sheath / meter marking
- Drum tolerance / Drum marking / End capping
- Packing, marking, and End sealing
- Drum design, materials, welding practice, packing, pulling tool & lifting tool as per QAP

DC Solar cable

- Routine Test

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- Conductor resistance (continuity test)
- HV test at room temp
- Absence of faults on Insulation
- Factory Acceptance Test
- Dimensions
- Annealing test for copper
- Tensile strength (for CU and AL both)
- Wrapping test (For Aluminium only)
- Thickness of Insulation and sheath
- Ovality
- Tensile strength and elongation at break for insulation, sheath & HDPE before ageing
- Hot set
- Conductor resistance test (Continuity test)
- High voltage test at room temp.
- Insulation resistance test (Volume resistivity)
- Flammability test
- Printing on outer sheath
- Spark test on outer sheath
- Drum tolerance / Drum marking
- Packing check of provision of min 4 wraps of polymeric material sheet on inner side of empty wooden drum & after winding of cables on drum in order to prevent direct contact of nails with PVC outer sheath

Inverter transformer

- Factory Acceptance Test
- Following Type Test & Routine test of the transformer shall be carried out in accordance with IS: 2026 / IEC 76 in the presence of Owner/Consultant representative:
- Measurement of winding resistance.
- Measurement of voltage ratio and check of phase displacement.
- Measurement of short-circuit impedance and load loss.
- Measurement of no load losses & current at 90%, 100% and 110%.
- Dielectric tests.
- Separate source AC withstand voltage test.
- Induced AC voltage test.
- Partial-discharge measurement.
- Lightning impulse voltage test.
- Measurement of insulation resistance and polarization index before and after HV test
- SFRA both at works and at site
- Temperature rise on one transformer.
- Dynamic Short circuit test. (Only Review of type test reports)
- Air pressure and vacuumed test.
- Phase imbalance test.
- Capacitance & tan delta for winding to earth & between windings
- Oil BDV test
- Functionality test of buchholz, PRV, WTI/OTI, MOLG, 2 kV test on auxiliary circuit

- Dimensional check



- Transformers shall be tested for Dynamic short circuit test as per latest IS/ IEC standards shall be preferred. Type test report and special test report test should be within last 5 years of similar or higher rating has to be provided.

Auxiliary transformer

- Factory Acceptance Test
- Measurement of winding resistance
- Measurement of voltage ratio and check for phase displacement
- Measurement of no load losses & current at 90%, 100% and 110%.
- Measurement of load losses
- Induced overvoltage withstand losses
- Separate source voltage withstand test
- Oil BDV test
- Insulation resistance
- Calculation of efficiency & regulation
- Dimensional check
- Oil pressure test

HT Panel

- Factory Acceptance Test
- BOM check & completeness
- Electrical operation @ no load
- Primary and secondary Current injection
- PT Circuit Check
- Resistance of main circuit
- Insulation resistance before and after HV
- HV test
- Breaker time interval test for trip and close
- Contact resistance measurement
- Cross ferruling check for inter panel wiring
- Paint shade & Thickness Verification
- Door alignment check
- Checking of identifications & danger plates
- PT truck alignment check
- Megger test before & After HV test
- High Voltage test in Control circuit
- High Voltage test on power circuit including VCB & busbar
- CT polarity check
- Earth continuity check
- Functional check/logic test
- Operation of VCB elect. & Mech. Spring charging operation
- Checking of VCB contact opening & closing time at rated voltage, at 70 to 110% of rated voltage
- Pick up & drop off voltage test for shunt trip and closing coil
- Checking of indicating instruments, relays through primary current injection
- Verification of indications of VCB at test & service positions
- Measurement of resistance of main circuit at 100A



- Checking of clearances between Phase, Neutral and earth
- Earthing switch operation + interlock
- IP protection

LT Panel

- Factory Acceptance Test
- Mechanical operation (on, off, trip operation)
- HV test
- IR test before and after HV
- Simulation test MFM
- Switchgears, CT and MFM
- CT
- BOM, GA and dimensional verification
- Switchgear operation check
- Earth fault detection
- TB check
- Incoming and outgoing cable entry
- Connection tightness
- Physical checking
- IP certification

Structure

- Factory Acceptance Test
- Galvanizing inspection
- Visual
- Thickness of zinc coating
- Weight of zinc coating
- Uniformity of zinc coating
- Adhesion test of zinc coating
- Packing, storing, Bundling and handling

Battery charger

- Routine Test
- Visual check
- IR test
- HV test
- Functional tests
- Temperature rise test at full load

Factory Acceptance Test

- Visual checks
- Verification of BOM, physical and dimension
- IR test
- HV test
- Functional test
- Front panel control
- Operating modes and operational logic test
- Automatic voltage regulation test at normal voltage and frequency with variation
- Ripple content at rated input and output voltage and current



- Efficiency and power factor test

UPS

- Routine Test
- Visual check
- IR test
- HV test
- Functional tests
- Temperature rise test at full load

Factory Acceptance Test

- BOM Check
- Insulation Resistance
- High Voltage Breakdown Test
- Indication & Alarm Test
- Load Regulation Test
- Overload Test
- Efficiency Test
- Voltage THD Test
- Restart Test
- AC Input Failure and Return Test
- Full load test (Output voltage, current, efficiency)
- Battery mode operation
- No load output voltage test
- Bypass operation test
- Manual Bypass operation
- Mains input voltage, DC voltage
- Temperature rise test (burn in test)

PLC

- Factory Acceptance Test
- Visual inspection of panel
- Dimensional check as per GA
- Colour
- Finish
- Internal and External
- Component assembly as per IGA & EGA drawing
- Workmanship
- Visual inspection of PLC unit
- Panel mountable items are checked
- For labelling
- For wiring
- BOM verification
- INPUT/OUTPUT module test
- Load Check of CPU
- Power supply test for CPU & Panel
- Burn in test



- Testing of engineering and operator station

Surge Arrestor

- Routine Test
- Reference voltage
- Residual voltage
- Grading leakage current
- Partial discharge test
- Sealing test
- Resistance of ground connection
- Resistive current drawn at rated voltage after energisation
- Counter operation and ammeter operation check

Conductor Stringing & Power Connectors

- Routine Tests
- Physical check for finish
- Electrical clearance check
- Testing of torque by torque wrenches on all bus power connectors and other accessories
- Sag, tension, elongation and torsion check on conductors
- Wrapping test on conductors
- Preece test

Station Earthing

- Check soil resistivity.
- Check continuity of grid wires
- Check earth resistance of the entire grid as well as various sections of the same. d)
Check for weld joint and application of zinc rich paint on galvanized surface.
- Dip test on earth conductor prior to use.



ANNEXURE C – Studies & Engineering Documents

S.NO.	DOCUMENT DESCRIPTION
A	GENERAL DOCUMENTS & STUDIES
1	Topography survey
2	Flood Risk Assessment & Hydrological study
3	Soil Test & ERT
4	Load Flow analysis
5	RE Control Operation Study
6	Healthy State (N) Voltage Profile
7	Power Flow intermittency analysis
8	Contingency Analysis
9	Short Circuit Analysis
10	Transient Stability Analysis
11	Fault Ride Through
12	Frequency Response Study
13	Reactive Power Response
14	Power Quality Study
15	Connection Assessment Study
16	Any additional studies notified by APSR/OETC/Distribution Company/CAA
B	CIVIL & STRUCTURAL ENGINEERING DOCUMENTS
1	Plant layout with co-ordinates
2	Design Basis Report-Civil
3	Module Mounting Structure – Structural Design and Detailed Drawings (with Robotic support system)
4	Module Mounting Structure- Design Calculation & Report
5	Module Mounting Structure Pile - Design Calculation & Report
6	Module Mounting Structure - GA & Fabrication drawing
7	Levelling & Grading Layout based on topography & hydrology report
8	Storm Water Drainage and Culvert System Design Report
9	Storm Water Drainage and Culvert System Layout & sectional drawing
10	Road Layout & Detailed Cross Sections
11	Inverter Foundation Design & Calculation
12	Inverter Foundation & Canopy Drawing
13	Equipment Shed & Foundation Drawing & Calculation- LT panel & HT panel / ICOG Panel
14	Equipment Foundation Drawing & Calculation - Inverter Transformer
15	Equipment Foundation Drawing & Calculation- NIFPS Panel Of IDT
16	Equipment Foundation Drawing & Calculation - Auxiliary Transformer
17	Equipment Foundation Drawing & Calculation - ICR & MCR
18	Equipment Foundation Drawing & Calculation - ESE LA
19	Equipment Foundation Drawing & Calculation - Street Light Pole
20	Equipment Foundation Drawing & Calculation – WMS
C	ELECTRICAL ENGINEERING DOCUMENTS



S.NO.	DOCUMENT DESCRIPTION
1	EYA (PVSyst) Report
2	Design Basis Report-Electrical
3	PV Array Layout (including palette number for Modules to be installed)
4	Single Line Diagram - DC System
5	Single Line Diagram - AC System
6	Single Line Diagram - Auxiliary System
7	String Inverter Grouping Layout
8	Cable Schedule - Control Cable
9	Cable Schedule - Communication Cable
10	Cable Sizing Calculations & Schedule - DC Cable
11	Cable Sizing Calculations & Schedule - AC Cable
12	Cable Sizing Calculations & Schedule – Auxiliary Cable
13	Cable Route Layout & Sections - DC - AC Cable
14	Cable Route Layout & Sections - ICR (IDT yard & systems)
15	SCADA I/O List
16	UPS & Battery Sizing Calculation
17	Auxiliary Transformer Sizing Calculation
18	Plant Lightning Protection System Layout & Calculations
19	Earthing system layout for Array, ICR & MCR
20	Earthing system calculations for Array, ICR & MCR
21	Illumination System Calculation & Drawings - ICR & MCR
22	Illumination System Calculation & Drawings - Peripheral Road
23	Relay Setting Calculation & Report
24	Inverter station Equipment Layout
25	Weather Monitoring Station Layout
26	Module Cleaning or robotic cleaning layout
27	Communication Cable Routing layout
28	CCTV System Layout
D	EQUIPMENT GTP
1	PV Modules
2	String Inverter
3	LT Panel
4	Inverter Duty Transformer (IDT)
5	NIFPS
6	Auxiliary Transformer – ICB
7	Auxiliary Distribution Boards like ACDB, UPSDB, LDB etc
8	MV ICOG / Switchboard Panel
9	DC Cables
10	AC Cables
11	Auxiliary Cables
12	Control Cables



S.NO.	DOCUMENT DESCRIPTION
13	Communication Cables
14	PV Connectors
15	WMS (Weather Monitoring System)
16	CCTV system
17	FAS - MCR
18	ESE Type Lightning Arrestor
19	Earthing Materials
20	Illumination system
21	UPS & Battery Bank
22	HT Termination Kit
23	Miscellaneous items like Lugs, glands, HDPE Pipes etc
F	MISCELLANEOUS DOCUMENTS
1	Civil Work - FQP
2	Electrical Work - FQP
3	Electrical- BOM
4	Civil - BOM
5	As Built Document - Civil
6	As Built Document - Electrical
7	As Built Document - Equipment



ANNEXURE D - Identification & Tagging of Components as per OA Product Specification & Functional Description

General

1. Each of the same type of marking component shall be by the same manufacturer.
2. Identification of components, cables and equipment shall include the following type of labelling:
 - Marking/Warning notice as per standards and regulations.
 - Reference labelling of electrical installations and items.
 - Nameplates.
 - Tag-numbering of equipment.
3. All instrumentation, equipment items and electrical installations including electrical accessories shall be marked and numbered using the guidelines specified in the document AL-000-H-13012.
4. Identification with directional, operational or warning labels shall be in Arabic and English language.
5. Labels shall be machine printed/engraved.
6. Labels installed shall be approved for installation in temperatures up to +70 °C.
7. Labels installed in direct contact with sunlight shall be of weather resistant, non-fading and pre-printed stainless steel.
8. Plastic markers shall be zero halogen.

Marking and warning notices

1. Markings and warning notices shall comply with OES 4, BS 7671, NFPA 70, IEC 60439-1 and the guidelines specified in the document AL-000-H- 13012.

Markings

1. Nameplates shall be engraved laminated nameplates, black with 3-6 mm high white lettering. The laminated nameplates shall as minimum be 1.6 mm thick for nameplates up to 124 cm² and as a minimum 3.2 mm thick for larger nameplates. The nameplates shall have 6 mm grommets in the corners for mechanical fastening. Nameplates shall be fastened with self- tapping stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.
2. Permanent indelible oval identifying markings, numbered using coloured heat shrinkable tube, or as chevron cut wire markers.

Cable ties

1. Shall be heavy duty type and match colour and quality of the markers.

Execution

General

1. The Contractor shall install identification devices according to the manufacturer's written instructions.
2. The Contractor shall coordinate the installation of the tag numbering prior to installing ceilings and similar finishes that conceal the tag numbering.
3. The Contractor shall coordinate the installation of the tag numbers with the completion of finishing works where the tag numbers are applied to the finished surfaces.

Reference labeling of electrical installations and items

1. A. Bus bar trunking system:
 - Colour and letter identification markers shall indicate the separate phases of bus bars in each substation and Switchboard. In addition the colour and letter identification shall be visible without disassembling current carrying supporting elements.



2. Conduit and cable identification:

- The identification shall be with permanent indelible oval identifying markings using carrier strip markers.
- Conduits and cables shall be marked in each end of the conduits or cables and where conduits or cables enters wall, ceiling or floor and shall be marked at 15 m intervals.
- Conduits and cables in manholes and pull-boxes shall be marked and properly arranged with visible and readable marking.

3. Wiring identification:

- The wiring shall be marked using permanent indelible oval identifying markings, numbered using coloured heat-shrink identification tubes, on both ends of wires or as chevron cut wire markers.

4. Luminaires, socket outlets, switches, push bottoms, ceiling roses and junction boxes:

- Labels shall be engraved laminated nameplates, white with 3 mm high black lettering indicating reference to the power supply panel and protection device.

5. For switchboards, circuit breakers and all outgoing feeders:

- Where individually enclosed or in substations and Switchboards, the labels shall be engraved laminated nameplates, black with 3 mm high white lettering.
- In Switchboard with doors, labelling shall also be mounted inside transparent plastic covers.

6. Uninterruptible power supply systems, emergency lighting, portable and fixed equipment, lightning protection, earthing and bonding systems, and fire stop systems:

- The components shall be tagged according to the other paragraphs in this section, meaning cables shall be tagged according to paragraph 2 and switch boards shall be tagged according to paragraph 5 and so on with all the components.

7. Device plates and other accessories:

- For device plates and other accessories of local toggle switches, toggle switch type motor starters, pilot lights, and the like whose junction is not readily apparent, plates shall be engraved with 3 mm high letters describing equipment controlled or indicated.

Nameplates

1. For substations and Switchboards:

- Engraved Traffolyte name plates, black with minimum 6 mm high white lettering.

2. For rooms:

- To switchboard rooms, electric closets, metal screened spaces assigned to electrical equipment, and the like shall be enamelled sheet metal, red on white, reading "Electrical Equipment Room - No Storage Permitted".

Tag-numbering

1. Field equipment panels shall be tagged with assigned instrumentation tag number and function. Tags shall be black Traffolyte with engraved white characters of 6 mm minimum height.

2. Field equipment and components shall be tagged with assigned instrumentation tag number. Tags shall be black Traffolyte with engraved white characters of 3 mm minimum height.

Cable trays, trunkings and ladders



1. Cable trays, trunkings and ladders identification plates shall be marked with engraved plates. The markings shall clearly state the type of installation within each compartment. In each room identification plates shall be installed and as a minimum marked at 15 m intervals.
2. Plates shall be engraved with 6 mm high letters describing installation.

Numbering of electrical terminals on equipment

1. All electrical terminals on equipment shall be marked using permanent indelible identifying markings.

Method Statement

for

Solar PV Projects

at

Muscat And Salalah

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SITE PREPERATION

1. Survey the Site: Conduct a detailed survey of the site to assess the terrain, soil conditions, and any potential obstacles or hazards.
2. Clear the Site: Clear the site of any vegetation, rocks, debris, or other obstacles that could interfere with the solar panel installation or pose a safety risk.
3. Level the Ground: Level the ground to ensure that it is suitable for the installation of the solar panels. This may involve excavation or filling, depending on the site conditions.
4. Install Access Roads: Construct access roads to the site to facilitate the transportation of equipment and materials.
5. Install Security Fencing: Install security fencing around the site to prevent unauthorized access and to protect the solar panels from theft or vandalism.
6. Install Drainage Systems: Install drainage systems to manage surface water runoff and prevent erosion.
7. Install Temporary Facilities: Install temporary facilities, such as site offices, storage areas, and welfare facilities for the construction workers.
8. Environmental Protection: Implement measures to protect the environment during the site preparation process, such as erosion control measures, sedimentation ponds, and waste management procedures.
9. Health and Safety: Implement health and safety measures to protect the workers and ensure compliance with local regulations. This may include the provision of personal protective equipment (PPE), safety training, and regular safety inspections.

PROJECT PLANNING & MANAGEMENT

1. **Project Planning:** Develop a detailed project plan, including timelines, budgets, and resource requirements, to ensure that the project is completed on time, within budget, and to the required standards.
2. **Project Team:** Assemble a competent project team with the required skills and experience to plan, design, install, test, and commission the solar project.
3. **Risk Management:** Identify, assess, and manage any risks associated with the project, including those related to safety, technical issues, environmental impact, and financial risks.
4. **Stakeholder Management:** Manage the expectations of all stakeholders, including investors, customers, regulators, and the local community, to ensure that the project is carried out smoothly and with minimal disruptions.
5. **Quality Control:** Implement a robust quality control system to ensure that all work is carried out to the required standards and specifications.
6. **Communication:** Establish clear communication channels with all stakeholders to ensure that they are kept informed about the project's progress and any issues that arise.
7. **Procurement:** Select and manage suppliers and contractors to ensure that they deliver the required quality and meet the project's timelines and budget.
8. **Health and Safety:** Implement appropriate health and safety measures to protect workers and stakeholders during the project's execution.
9. **Commissioning and Handover:** Plan and manage the testing, commissioning, and handover of the solar project to ensure that it meets the required performance standards and is ready for operation.

ENGINEERING DESIGN

1. Site Survey Report - This report provides information about the site conditions such as location, size, slope, soil, shading analysis, and accessibility, which will help in determining the best placement and orientation of the solar panels.
2. Field Studies - These studies are commissioned for evaluating topography, geo-tech properties and hydrology features of site for Civil & Structural Design. Additionally, studies will have to be commissioned as per guidelines provided by APSR for Electrical Design of the plant.
3. Electrical Single Line Diagram (SLD) - The SLD shows the electrical connections and components of the solar plant, including the solar panels, inverters, transformers, switchgear, and distribution lines.
4. System Block Diagram - This diagram provides an overview of the solar plant system, showing how the solar panels, inverters, and other components are interconnected to form a complete system.
5. Structural and Civil Drawings - These drawings provide the structural and civil design details of the solar plant, including the foundation, mounting structure, cable trenches, and electrical rooms. It also involves utilities like roads, drains, fencing, cleaning water arrangement etc.
6. PV Array Layout - The PV array layout plan shows the layout of the solar panels, including the number of panels, their orientation, and tilt angle.
7. Wiring Diagrams - These diagrams show the wiring connections between the solar panels, inverters, and other electrical components of the system.
8. Equipment Data Sheets - These sheets provide the technical details of various equipment used in the solar plant, such as the solar panels, inverters, and mounting structures.
9. Operation and Maintenance Manual - This manual provides the necessary information for the proper operation and maintenance of the solar plant, including procedures for troubleshooting, repairs, and replacement of components.
10. Safety Plan - This plan outlines the safety procedures and protocols to be followed during the construction and operation of the solar plant, including measures to prevent accidents, fire, and other hazards.
11. Permit Applications - These documents include the necessary permits and approvals from local and state authorities for the construction and operation of the solar plant, including building permits, electrical permits, and environmental permits.

PV MODULE

1. Selection: 580Wp or higher rating to be considered. Bi-facial or Monofacial can be selected based on generation targets and other design factors.
2. Mounting Structures: Install the mounting structures for the solar panels. This may involve drilling, welding, or bolting, depending on the type of structure being used.
3. Positioning of Solar Panels: Position the solar panels on the mounting structures, ensuring that they are correctly aligned and spaced as per the manufacturer's instructions.
4. Electrical Connections: Connect the solar panels to the electrical cabling, which will carry the power generated by the panels to the inverter. Ensure that the cables are properly secured and protected from damage. Ensure that connectors are crimped using approved tools and methods in line with OEM guidelines.
5. Grounding: Ground the solar panel mounting structures and the electrical system as per the local regulations and the manufacturer's instructions.
6. Testing: Test the solar panels to ensure that they are functioning correctly. This may involve measuring the voltage and current output of each panel and checking for any defects or damage.
7. Quality Control: Conduct regular quality control checks to ensure that the installation meets the required standards and specifications. In-line or pre-dispatch inspection is must. Sample testing can be done at site or at a third party testing lab.
8. E-Waste Disposal: Implement measures to ensure compliance with waste management procedures and guidelines of the region.
9. Documentation: Maintain all the necessary documentation, including the factory IV Curves, EL images, and test reports.
10. Current Binning: Ensure modules supplied are having current binning markings and the same is followed during installation.

INVERTER

1. Selection: inverters must be selected in compliance to module stringing voltage and following a well-defined overloading which is in compliance with OEM guidelines. Inverter technology shall be string type and such inverters shall be able to operate in parallel. Proper switchgear and protection needs to be provided as recommended by OEM. grid connectivity features shall be in compliance with local guidelines.
2. Electrical Connections: Run the electrical cables from the solar panels to the inverter location. Ensure that the cables are protected from damage and properly secured.
3. Mounting: Mount the inverters as per the manufacturer's instructions. Ensure that they are securely fastened to the wall or other support structure. Ensure that the area is clean and free of debris. Identify the location for the inverter installation, which should be in a dry, well-ventilated area
4. Wiring: Connect the inverters to the electrical cables from the solar panels and to the electrical distribution system. Ensure that the wiring is done as per the manufacturer's instructions and local regulations.
5. Grounding: Ground the inverter and the electrical system as per the local regulations and the manufacturer's instructions.
6. Testing: Test the inverters to ensure that they are functioning correctly. This may involve measuring the voltage and current output and checking for any defects or malfunctions.
7. Commissioning: Once the inverters have been installed and tested, commission the system as per the local regulations.
8. Quality Control: Conduct regular quality control checks to ensure that the installation meets the required standards and specifications.
9. Documentation: Maintain all the necessary documentation, including the system design, installation drawings, and test reports.

MODULE MOUNTING STRUCTURE

1. **Proper Design:** The mounting structure must be designed specifically for the solar panel type and size, taking into consideration factors such as wind loads, seismic loads, and the location of the installation.
2. **Quality and Durability:** The mounting structure should be made of high-quality materials that are durable and corrosion-resistant, to ensure that they can withstand the coastal environmental conditions.
3. **Proper Installation:** The mounting structure must be installed properly, using appropriate tools and techniques, to ensure that it is securely attached to the ground surface.
4. **Structural Integrity:** The mounting structure must be designed using latest version of applicable softwares like StaadPro, Solidworks, Ansys etc. Wind load calculations must consider applicable loading cases.
5. **Compliance with Local Regulations:** The installation of the mounting structure must comply with all local regulations and codes, including those related to building permits, structural requirements, and electrical safety.
6. **Accessibility:** The mounting structure should be designed to provide easy access for maintenance and cleaning of the solar panels.
7. **Quality Control:** Regular quality control checks should be conducted during the installation process to ensure that the mounting structure meets the required standards and specifications.

CABLING

1. **Proper Sizing:** The cables used in the solar project must be sized properly to ensure that they can carry the required current load without overheating or causing a voltage drop beyond pre-determined limits which is typically 2%
2. **Quality and Durability:** The cables must be made of high-quality materials that are durable and able to withstand the environmental conditions prevailing at site.
3. **Proper Routing:** The cables must be laid strictly following the prescribed routes. It should be ensured that they are protected from damage and properly secured.
4. **Cable Management:** The cables must be managed properly, including labelling, bundling, and termination, to ensure that they are organized and easily accessible for maintenance and troubleshooting.
5. **Compliance with Local Regulations:** The installation of the cables must comply with all local regulations and codes, including those related to electrical safety and fire protection.
6. **Proper Termination:** The cables must be terminated properly, using appropriate tools and techniques, to ensure that they are securely connected to the solar panels, inverters, switchgear and grid connection point. Termination guidelines prescribed by OEM must be followed.
7. **Quality Control:** Regular quality control checks should be conducted during the installation process to ensure that the cables meet the required pre and post installation quality.

CIVIL WORKS

A stepwise quality plan for civil works in a solar project may include the following:

1. Planning Phase

- Develop a detailed quality plan outlining the requirements, standards, and procedures for the civil works.
- Define the roles and responsibilities of the project team, including the quality control personnel.
- Review the design drawings, specifications, and any other relevant documentation to ensure that they meet the project's quality requirements.

2. Pre-Construction Phase

- Conduct site inspections to verify that the site is suitable for the civil works and identify any potential issues that may affect quality.
- Review the site investigation report to ensure that the civil works comply with the site conditions.
- Verify that the materials and equipment to be used in the civil works meet the required standards and specifications.

3. Construction Phase

- Verify that the construction activities are carried out in accordance with the quality plan, design drawings, and specifications.
- Monitor the quality of the construction work, including excavation, foundation, structure, and finishing works.
- Conduct regular inspections and testing of the materials and equipment used in the civil works to ensure compliance with the required standards and specifications.
- Document and report any deviations from the quality plan, and develop corrective and preventive actions.

4. Post-Construction Phase

- Conduct a final inspection of the completed civil works to ensure that they meet the required quality standards.
- Verify that all the necessary permits and certificates are obtained before commissioning the solar project.
- Develop an operations and maintenance plan to ensure that the civil works remain in good condition and continue to meet the required quality standards.

TESTING & COMMISSIONING

1. **Electrical Safety:** Ensure that all safety precautions are taken during testing and commissioning to prevent any electrical hazards.
2. **Documentation:** Prepare and review all the necessary documentation, including the design specifications, drawings, and test reports.
3. **Functionality:** Test the functionality of all the components of the solar project, including the solar panels, inverters, switchgear, and monitoring systems, to ensure that they are working correctly and efficiently.
4. **Performance:** Measure and verify the performance of the solar project, including the power output, efficiency, and any other relevant parameters, to ensure that it meets the design specifications and contractual obligations.
5. **Compliance:** Ensure that the solar project is compliant with all the relevant regulations and standards, including those related to electrical safety, energy efficiency, and environmental impact.
6. **Verification:** Verify that all the installation and commissioning procedures have been carried out correctly and that the solar project is ready for operation.
7. **Training:** Provide training to the end-users, maintenance personnel, and operators of the solar project to ensure that they are familiar with the system's operation, maintenance, and troubleshooting.
8. **Ongoing Maintenance:** Establish a regular maintenance schedule to ensure that the solar project continues to operate efficiently and safely.
9. It is important to ensure that all electrical work is done by qualified personnel and in compliance with the local regulations and codes, including that of customer.

Annexure C

Annexure C1

Summary of Bid

(To be submitted on Bidder's Letter Head)

Name of Work: Design, Engineering, Supply, Construction, Testing, Commissioning including Operation and Maintenance of 20MW (Muscat) & 6MW (Salalah) Solar PV Projects on Asset Lease Basis for Fixed Tenure.

Tender Id: <Insert Tender ID>

To,
Oman Airports,

Dear Sir/Ma'am,

We acknowledge the receipt of your RfP to bid which was received on (DATE) and understand that the documents received remains property of OA.

We are interested to participate in this RfP and are submitting herewith our offer for Design, Engineering, Supply, Construction, Testing, Commissioning including Operation and Maintenance of 20MW (Muscat) & 6MW (Salalah) Solar PV Projects on Asset Lease Basis for Fixed Tenure in the manner prescribed in the Instructions for preparation and submission of bid duly signed by a person authorized on behalf of our Company / Firm.

Power of Attorney in favor of the person authorized to sign this offer is also enclosed.

Date:

Place:

(Signature of the Authorized Representative of Bidder)

Name

Designation

Seal of Company

Annexure C2

Declaration of Compliance and Deviation Schedule

(To be submitted on Bidder's Letter Head)

Name of Work: Design, Engineering, Supply, Construction, Testing, Commissioning including Operation and Maintenance of 20MW (Muscat) & 6MW (Salalah) Solar PV Projects on Asset Lease Basis for Fixed Tenure.

Tender Id: <Insert Tender ID>

To,
Oman Airports

Dear Sir/Ma'am,

We declare that the following are the only deviations/variations/exceptions from the specifications contained in RfP for Design, Engineering, Supply, Construction, Testing, Commissioning including Operation and Maintenance of 20MW (Muscat) & 6MW (Salalah) Solar PV Projects on Asset Lease Basis for Fixed Tenure.

The schedule has been filled with full care, except these deviations which shall be subject to the approval and acceptance by OA. The entire work shall be performed as per your specifications and documents. Further, we agree that additional conditions if any found elsewhere in our offer other than those stated below, other than pertaining to any rebates offered by OA, shall not be given effect to.

Document Ref.	Clause Ref.	Page	Reason	Statement of Variations and Deviations

Note: Use additional sheets of the same format, if required.

Date:

Place:

(Signature of the Authorized Representative of Bidder)

Name

Designation

Seal of Company

Annexure C3

Financial Criteria Qualification of the Bidder

(To be submitted on Bidder's Letter Head)

Name of Work: Design, Engineering, Supply, Construction, Testing, Commissioning including Operation and Maintenance of 20MW (Muscat) & 6MW (Salalah) Solar PV Projects on Asset Lease Basis for Fixed Tenure.

Tender Id: <Insert Tender ID>

To,
Oman Airports

Dear Sir/Ma'am,

We, <Company Name> declare that we are the Lead Bidder for this RfP and declare that we meet the qualification criteria laid in the RfP. Following is the summary of our audited financials.

LEAD BIDDER'S FINANCIAL SUMMARY	
Financial Year 2020-21 Turnover (in OMR)	
Financial Year 2021-22 Turnover (in OMR)	
Financial Year 2020-21 Net worth (in OMR)	
Financial Year 2021-22 Net worth (in OMR)	
Financial Year 2020-21 EBIDTA (in OMR)	
Financial Year 2021-22 EBIDTA (in OMR)	

We, <Company Name> declare that we are not Black-Listed by any Public and Private Companies/ group/ bodies/ agencies/ Government offices.

DECLARATION

I, (authorized representative's name) on behalf of <Company Name> hereby declare that the details mentioned above are true and correct. Our Bid at subsequent stages is liable to be rejected if the above information is found to be untrue/unsubstantiated at any time during the evaluation process.

Date:

Place:

(Signature of the Authorized Representative of Bidder)

Name

Designation

Seal of Company

Annexure C4

Format for Power of Attorney

(To be provided by the Bidding Company / Lead Member in favor of its representative as Evidence of Authorized Signatory's Authority)

Name of Work: Design, Engineering, Supply, Construction, Testing, Commissioning including Operation and Maintenance of 20MW (Muscat) & 6MW (Salalah) Solar PV Projects on Asset Lease Basis for Fixed Tenure.

Tender Id: <Insert Tender ID>

KNOW ALL MEN BY THESE PRESENTS, that we, (Name of the Bidder/Lead Member of consortium), a Company/ Corporation/ Firm organized and existing under and by virtue of the laws of (Name of Bidder's country) and having its registration number as ----- and its registered office at [] (address of the Bidder) do hereby irrevocably constitute, appoint, and authorize ----- (Name and residential address) who is presently employed with us and holding the position of -----, as our true and lawful attorneys to do in our name and on our behalf prepare, make, sign and submit the bid proposals and other documents, certificates, undertakings and papers to be executed and delivered by us, and to do all such acts, deeds and things as are necessary or required in relation to the RfP issued by OA for Design, Engineering, Supply, Construction, Testing, Commissioning including Operation and Maintenance of 20MW (Muscat) & 6MW (Salalah) Solar PV Projects on Asset Lease Basis for Fixed Tenure.

AND we hereby agree to ratify and confirm and do hereby ratify and confirm all acts, deeds and things lawfully done or caused to be done by our said attorneys pursuant to and in exercise of the powers conferred by this power of attorney and that all acts, deeds and things done by our said attorneys in exercise of the powers hereby conferred shall and shall always be deemed to have been done by us.

Signed by the within named

[Insert the name of the executant company] through the hand of

Mr./Ms.

duly authorized by the Board to issue such Power of Attorney Dated this
..... day of

Accepted

Signature of Attorney

(Name, designation and address of the Attorney)

Attested

(Signature of the Executant)

(Name, designation and Address of the Executant)

Signature and stamp of Notary of the place of execution

Common seal of has been affixed in my/our presence pursuant
to Board of Director's Resolution dated.....

WITNESS

1.

Signature.....

Name.....

Designation.....

Occupation.....

2.

Signature.....

Name

Designation

Note:

The mode of execution of the power of attorney should be in accordance with the procedure, if any, laid down by the applicable law and the charter documents of the executant(s) and the same should be under common seal of the executant affixed in accordance with the applicable procedure. Further, the person whose signatures are to be provided on the power of attorney shall be duly authorized by the executant(s) in this regard.

Also, wherever required, the executant(s) should submit for verification the extract of the chartered documents and documents such as a Board resolution/Power of attorney, in favour of the Person executing this power of attorney for delegation of power hereunder on behalf of the executant(s).

Annexure C5

Lease Options Offered

(To be submitted on Bidder's Letter Head)

Name of Work: Design, Engineering, Supply, Construction, Testing, Commissioning including Operation and Maintenance of 20MW (Muscat) & 6MW (Salalah) Solar PV Projects on Asset Lease Basis for a fixed tenure.

Tender Id: <Insert Tender ID>

Lease Tenure Ending	For Muscat Monthly Lease Amount (in OMR)	For Salalah Monthly Lease Amount (in OMR)
10 th		
15 th		
20 th		
25 th		

We, <Company Name> declare that the lease schedule filled above is in line with the APSR Solar Lease Guidance prevalent at the time of submitting this schedule.

We, <Company Name> additionally declare to pass on to OA, any other direct or indirect incidental benefits originating from setting up this project. Our quoted monthly lease amount shall be the only rightful claim towards OA.

Date:

Place:

(Signature of the Authorized Representative of Bidder)

Name

Designation

Seal of Company

Annexure C6

Energy Forecast Schedule

(To be submitted on Bidder's Letter Head)

Name of Work: Design, Engineering, Supply, Construction, Testing, Commissioning including Operation and Maintenance of 20MW (Muscat) & 6MW (Salalah) Solar PV Projects on Asset Lease Basis for Fixed Tenure.

Tender Id: <Insert Tender ID>

Year	For Muscat Annual Energy Forecast (in kWh)	For Salalah Annual Energy Forecast (in kWh)
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		
16		
17		
18		
19		
20		
21		
22		
23		
24		
25		

Date:

Place:

(Signature of the Authorized Representative of Bidder)

Name

Designation

Seal of Company

Annexure C7

Asset Transfer Mechanism Post Lease Tenure

(To be submitted on Bidder's Letter Head)

Name of Work: Design, Engineering, Supply, Construction, Testing, Commissioning including Operation and Maintenance of 20MW (Muscat) & 6MW (Salalah) Solar PV Projects on Asset Lease Basis for Fixed Tenure.

Tender Id: <Insert Tender ID>

To,
Oman Airports

Dear Sir/Ma'am,

We, <Company Name> declare that we will transfer the asset to OA upon the completion of fixed lease tenure and there will be no transfer fee applicable for the same.

At the time of asset transfer, <Company Name> will appoint a mutually agreed independent third party to conduct a comprehensive Energy Yield Assessment (EYA) covering forecasted performance of all major equipment and furnish complete health checkup report of the asset clearly stating the Energy Forecast for remaining life of the asset. and a list of the required spares. We will provide comprehensive training to OA staff for the Operation and Maintenance of the asset.

In the years post lease tenure, if such Energy Forecast is found to be lesser than Annexure - "Energy Forecast Schedule" submitted by bidder along with this bid, then bidder will compensate OA reasonably (As per provisions to be incorporated in the lease agreement mutually)

Date:

Place:

(Signature of the Authorized Representative of Bidder)

Name

Designation

Seal of Company

Annexure C8

Bidder's Queries Format

Name of Work: Design, Engineering, Supply, Construction, Testing, Commissioning including Operation and Maintenance of 20MW (Muscat) & 6MW (Salalah) Solar PV Projects on Asset Lease Basis for Fixed Tenure.

Tender Id: <Insert Tender ID>

S. No.	Category	Document Ref.	Clause Ref.	Query
1	Financial/Technical			
2	Financial/Technical			
3	Financial/Technical			
4	Financial/Technical			
5	Financial/Technical			

Date:

Place:

(Signature of the Authorized Representative of Bidder)

Name

Designation

Seal of Company.....

Annexure C9

Compliance to CAA No Objection Certificate Requirements

(To be submitted on Bidder's Letter Head)

Name of Work: Design, Engineering, Supply, Construction, Testing, Commissioning including Operation and Maintenance of 20MW (Muscat) & 6MW (Salalah) Solar PV Projects on Asset Lease Basis for Fixed Tenure.

Tender Id: <Insert Tender ID>

To,
Oman Airports

Dear Sir/Ma'am,

We, <Company Name> declare that we have received, read and clearly understood the No Objection Certificates issued by Civil Aviation Authority to Oman Airports (CAA-NoCs), individually for Muscat (MCT) Airport and Salalah (SLL) Airport for setting up and operating the respective Solar Projects.

Having understood CAA-NoCs and done our own Due Diligence, We will ensure that our Solar Project Design, Components and O&M Practices will be compliant with the guidelines & conditions laid out by CAA for setting up and operating the subject Solar projects specifically in context of HSE, Wildlife and Glare. We will also ensure that none of the equipment installed for proper and complete functioning of the both Solar Project projects, will interfere in the Airport Operations and Navigation systems.

We understand that CAA-NoC's validity is for one year and in case a renewal is required, we will support OA with the required documentation and addressing any subsequent queries from CAA.

Date:

Place:

(Signature of the Authorized Representative of Bidder)

Name

Designation

Seal of Company

Solar Lease Guidance

A number of customers want to secure electricity from other sources, The Authority enables such customers, especially C-RT customers, who are not able to install their own plant, to secure electricity from developers/investors through their Solar PV Plant.

In general, leased facilities must meet the following requirements:

1. Must generate electricity from a renewable energy resource;
2. Must have a generating capacity of not more than twenty-five kilowatts (25 MW) otherwise article 108 will be applicable.
3. Must be interconnected and operated in an approved manner by the distribution, supply or a transmission company;
4. Must meet applicable safety, performance, interconnection, and reliability standards.

As to the Developer's conveyed intention to enter into agreements for leasing projects, the Authority sets hereunder the main criteria which must be met when forming asset lease agreements ("ALAs") for future Solar PV Plants to be entered into with autogenerators:

- 1- Pursuant to Article (74) of the Sector Law issued by the Royal Decree No. (78/2004) (Sector Law), Any ALA drafted in a manner that is understood to be a Power Purchase Agreement will not be granted the Authority's approval.
- 2- The ALA has to ensure that the lessor (Developer) leases solar PV plant to the Lessee (Autogenerator) through a fixed leasing fee regardless of the annual tariff or units generated by the solar PV plant, except for operational reasons (such as planned outages for maintenance) the variation in the lease fee is expected to be in the form of a fixed percentage. The solar lease monthly rate covers the solar system itself, rather than the cost of electricity
- 3- The lease payments would be fixed throughout the term of the lease. These payments, would be independent of electric generation, production rates, or any other operational variable of the facility.
- 4- In case the Lessor fails to meet its obligations, the Lessee may penalize the Lessor either by a fixed percentage or a fixed amount of money, which shall not depend on the exact amount of electricity generated. The annual performance clause must be based accordingly.
- 5- Each solar PV plant and its connections should be dedicated to one Lessee only.

- 6- Such Solar PV plant leased to an Autogenerator for Self Supply shall not be connected to a System of a Licensee.
- 7- Autogenerators might be required to apply for an Exemption if the Autogenerator is subject to the provisions of Article (108) of the Sector Law.
- 8- The Customer shall seek the Authority's written approval for every asset lease agreement entered into with a Developer.

Review Process:

“APSR” is implementing the following process to review/approve PV systems based on Lease Agreement Business Model to ensure the solar project is being of a leasing nature and not a Power Purchase Agreement (PPA) :

- 1) Lease based business model (and not the PPA type business model) for all customer's is acceptable going forward subject to APSR approval for each case.
- 2) The customer themselves have to approach APSR with the lease agreement for APSR team to review/approve on the acceptability of the model what the customer is trying to agree with him and the developer.
- 3) The customer can appoint the developer to act on their behalf to approach the APSR with appropriate nomination letter.
- 4) Agreements is reviewed by the regulatory, legal, and technical, departments to ensure a vast array of perspectives during the approval process. The team reviews the application, analyzes the supporting documentation, and makes a determination.
- 5) If all the legalities and documentation is in order, APSR will provide the approval of the lease based PV system under the customer's name. APSR final approval is only provided once signed/executed documents are submitted.
- 6) The approvals under this business model will be based on zero generation export to the grid.
- 7) The time required to complete our review depends on how complete is the customer's submission. The review process is usually finalized within thirty days of receiving a complete application.

I have read and understood the safety guidelines and code of practice for contractors and abide by all the guidelines, procedures while undertaking the Project.

I shall be responsible to ensure that all the safety procedures will be followed by our organization, all the control measures as identified in the risk assessments will be in place and put into practice to bring down the risks to as low as reasonably practicable level.

Name:

Signature:.....

Date:

Designation:

Organization:

**Health & Safety related Documents to be submitted by
the Contractor before Start of the Project**

Sr. No	Document	Status of Submission		
		Yes	No	NR
1	Company HSE Plan/Safety Policy Document			
2	Method statement specific to the project undertaken			
3	Risk Assessment specific to the project undertaken			
4	Copies of Insurance documents as per the tender document			
5	Necessary permits taken prior to start of the job			

Oman Airports Management Company

Health & Safety Procedures

Code of Practice for Contractors

GENERAL SAFETY REQUIREMENTS

- 1.0 Definitions & Abbreviations
- 1.1 Health and Safety Management
- 1.2 Training
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1.0 Definitions and Abbreviations

Accident: An occurrence associated with the operation of an aircraft, which takes place between the times a person boards the aircraft with the intention of flight until the persons have disembarked, in which

- a) a person is fatally or seriously injured as a result of: being in the aircraft or direct contact with any part of the aircraft, including parts which have become detached from the aircraft, or direct exposure to jet blast except when the injuries are from natural causes, self-inflicted or inflicted by other persons, or when the injuries are to stowaways hiding outside the areas normally available to the passengers and crew; or an unplanned event that results in harm to people, damage to property or loss to process.

Assessment: An activity to determine whether a reported hazard is in fact a risk to aerodrome safety in any way. The outcome of an assessment is to classify all reported hazards, incidents and accidents as a risk of a certain magnitude. Assessment involves transitioning reported hazards and events into risks so that they can be dealt with in a meaningful way.

Agent– means the name, address and contact details of the person who is authorized to act on behalf of the applicant and where all correspondence should be sent if this person and address is different from the entity

Aerodrome– means a defined area of land or water including any buildings installations and equipment intended to be used either wholly or in part for the arrival, departure and surface movement of aircraft.

Authority (PACA) - Public Authority for Civil Aviation.

ADM - Airport Duty Manager

ADP - Airside Driving Permit

AEP - Airport Emergency Plan

AFDM - Airfield Duty Manager

AVP - Airside Vehicle Permit

CAR - Civil Aviation Regulation

CEI - Chief Executive Instructions

Chief Executive Officer (CEO) – means a person with overall operational responsibility for a particular aerodrome.

Company - Oman Airports Management Company

Cost: Cost of activities, direct, indirect, involving any negative impact, including money, time, labour, disruption, goodwill, political, and tangible losses.

Critical Safety Information: Is the sort of information that staff and management need to be aware of, in order to do their job. Typically, this would include information like a change to a company procedure required as part of a safety risk treatment option.

Dangerous Occurrence: An area or location where the probability of injury is high leading to an accident or incident or other undesired safety- related event

Defenses: Are actions or elements of a design put in place to reduce the likelihood or consequence of an event. Risk treatment will normally involve the introduction or enhancement of defenses against a specific negative outcome.

Deficiency: The result of lacking something essential; imperfect; defective. Such as hazards allowed existing within a system result in a System Deficiency

DGAN - Directorate General of Air Navigation

DGCAR - Directorate General of Civil Aviation Regulation

DGM - Directorate General of Meteorology

EI - Engineering Instruction

Environment Damage: Damage to the surrounding conditions, influences, and forces to which an employee is exposed in the workplace.

Facility - means premises being used, or to be used, for the operation of an aircraft on the aerodrome. These premises may be fixed or portable, and may include communication facilities.

FOD: Foreign object debris (FOD) is a substance, debris or article alien to a vehicle or system which would potentially cause damage.

Fault: “Fault (or) Failure” means an occurrence, which affects the operation of a component. Part or element such that it can no longer function as intended.

Hazard: A source of potential harm or a situation with a potential to cause loss.

HSE - Health Safety and Environment

Incident: An occurrence, other than an accident, associated with the operation of an aircraft that affects or could affect the safety of operation. A serious incident is an incident involving circumstances indicating that an accident nearly occurred, (ICAO Annex 13) or an occurrence other than an accident, associated with the operation of equipment or system, which affects or could affect the safety of operation

IATA - International Air Transport Association

ICAO - International Civil Aviation Organization

L & D - Learning and Development

Likelihood: Used as a qualitative description of probability or frequency.

LTI: Lost time injuries refer to accidents or injuries that force the employee or contractor to remain away from his or her work beyond the day of the accident or for the next shift. They are those occurrences that result in a fatality, permanent disability or time lost from work of one day, shift or more.

Mitigation: The actions taken to control, reduce or remove a hazard or to reduce the probability or the severity of a risk. The result of an action to make milder or less severe.

Monitor: To check, supervise, observe critically, or record the progress of an activity or system on a regular basis in order to identify change.

MDM - Maintenance Duty Manager

MDO - Maintenance Duty Officer

MIA - Muscat International Airport

MM - Maintenance Manager

Near Miss: Incident can be defined as , “ any event, which under slightly different circumstances, may have resulted in injury or ill health of people, or damage or loss to property, plant, materials or the environment or a loss of business opportunity.

NOTAM - are unclassified notices or advisories distributed by means of telecommunication that contain information concerning the establishment, conditions or change in any aeronautical facility, service, procedure or hazard, the timely knowledge of which is essential to personnel and systems concerned with flight

Occurrence: An accident or incident or other undesired safety- related event.

OA - Oman Air

OAMC- MCT - Refer to Muscat International Airport

Operator - has the same meaning as" company"

Owner - mean the legal entity holding the Aerodrome Certificate

Probability: The likelihood of a specific outcome.

Risk: The chance of something happening that will have an impact upon objectives. It is measured in terms of consequences and likelihood.

Risk analysis: A systematic use of available information to determine how often specified events may occur and the magnitude of their consequences.

Risk assessment: The overall process of risk analysis and risk evaluation.

Risk evaluation: The process used to determine risk management priorities by comparing the level of risk against predetermined standards, target risk levels or other criteria.

Risk identification: The process of determining what can happen, why and how.

Risk level: The level of risk calculated as a function of likelihood and consequence.

Risk management: The culture, processes and structures that are directed towards the effective management of potential opportunities and adverse effects.

Safety: A state or condition in which persons are or feel protected, as far as practical, from the risk of injury. In employment reasonable safety is provided through control of the working environment, work methods, machinery, plant and equipment, through measures adopted to influence the human factors conducive to accident and injury. These amounts to the application of positive accident prevention.

Safety Management System: A Safety Management System is an integrated set of management practices, beliefs and procedures for monitoring and improving the safety and health aspects of the organisations.

1.1 Health and Safety Management

The contractor where appointed should note that, in accordance with conditions of contract, he is responsible for the safety of site operations.

The contractor shall comply with all the requirements described herein without detracting from his responsibilities under the contract.

The contractor shall throughout the progress of the works comply with his duties under all approved codes and all relevant health and safety legislation. Where no specific legislative requirements exist, the contractor shall comply with guidance provided by codes of practice or Industry standards as a minimum standard of safety.

The contractor must adhere to the **Health ,Safety & Environment Policy** of Oman Airports Management Company (OAMC) that enclosed as **Annexure 1**.

The Contractor shall be responsible for ensuring compliance with this document throughout the project including the activities of his appointed sub-contractors or temporary visitors.

The contractor shall submit with any tender, or if there is no tender required prior to any works Commencing, the following:

1. Company Safety Policy Document
2. Risk Assessments and method of work plan
3. Copies of Insurance documents as per the tender document
4. Details of any prohibition or improvement notices and prosecutions by the enforcing authorities, during the last 3 years.

The basic safety rules and procedures designed to enable OAMC to establish a method for, controlling the activities of contractors employed in any discipline of work at Muscat and Salalah & at all regional airports (Sohar, Duqm) and to ensure safe systems of work and safe working practices are given as Procedure for Control of Contractors ([CEI /06](#))attached as **Annexure 2** .

1.2 Training

The contractor shall ensure that all employees (including sub-contractors) are adequately trained to carry out their particular duties or tasks including driving machines and operating equipment. In addition, the Contractor staffs must undergo Induction Training imparted by HSE department of OAMC.

1.3 Risk Assessment

Before any work commences on site, the contractor shall identify all the hazards associated with the activities being undertaken and carry out risk assessments of all operations where risk is foreseeable and ensuring that appropriate control measures are established and incorporated into safe systems of work. The risk assessment must be submitted to OAMC HSE Manager (Corporate) or the HSE HEAD /In Charges of respective Airports for his perusal. The contractor shall use these safe systems of work as the basis for the health and safety method statements. All method statements shall be developed and submitted to HSE HEAD/In charges in all airports. The method statement must give details of how the work will be undertaken and be specific to the project.

The objective of risk assessment is to highlight project related hazards and to develop methods to deal with those hazards by putting barriers and defenses and control measures.

These assessments shall be in writing and include but not restricted to the following activities:

- Major Construction Elements
- General public and third party safety
- Location of site access/egress
- Vehicle movements on and off site
- Vehicle, Machinery and equipment hazards within the site
- Vehicle/Pedestrian segregation
- Temporary services distribution
- Location of static machinery and equipment
- Scaffolding
- Trench/Ground works
- Electrical Work
- Hazardous Chemicals Services Clearances
- Construction Materials
- Storage, use and disposal of substances hazardous to health
- Noise
- Working at heights
- Excavation and underground services
- Manual Handling
- Use of portable hand tools
- Emergency procedures including evacuation routes
- Fire
- Materials storage
- Site hoarding
- Contaminated ground
- Lifting new elements of structure

All risk assessments shall be reviewed and revised as necessary to accommodate any changes in methods of working, machinery, equipment, material and/or site development. Project Manager and HSE HEAD/ In Charge in all airports will be

available to liaise on all matters of health and safety relevant to these risk assessments.

OAMC Risk Assessment Procedure attached as Annexure - 3 and the risk assessment Proforma as Annexure-4

1.4 Housekeeping

Housekeeping is of paramount importance. Contractors shall set down and make available to the management team their system for maintaining a clean, tidy and safe site. Contractors shall ensure the site is continuously monitored to ensure standards are maintained.

1.5 Permits to Work

The contractor shall ensure that when working within Oman Airports Management Company all “Permits to Work” or authorizations have been obtained from OAMC authorized Person.

(Refer Engineering Instruction EI/02 -Service Clearance and Permit to Dig. attached as Annexure 5) for the type of work covered in the following clauses of this document.

- Hot work permit
- Confined spaces (Even though there is no form is used for it but all the precautions must be taken needs to reflect in Method Statement & Risk Assessment so that HSE department will be aware of the work.)
- Electrical equipment
- Excavations and openings

- Working at Height (Even though there is no form is used for it but needs HSE department's necessary permission prior to start the work.)

Where the assessment conducted identify high risk activities which demand the strict application of an approved safe system of work, the contractor shall devise and operate appropriate control measures which may include a “permit to work” system under the direct supervision of an appointed competent person. The Contractor shall follow **Refer Engineering Instruction EI/02- Service Clearance and Permit to Dig. attached as Annexure 5.**

1.6 Protection against Noise.

Sources of noise should be eliminated where practicable. Contractors are responsible for providing and ensuring the use of suitable hearing protection by their employees and their subcontractors.

1.7 Protection against Fire.

General.

Contractors must conform to the requirements of Fire Safety Standards for Oman Airports Management Company. They shall fill up the **Hot Work Permit(attached as Appendix H) and** take necessary approval from Chief Fire Officer prior to start any hot work.

The fire risk assessment and emergency procedures shall be discussed with the Project Manager and fire precautions shall be agreed prior to commencement of works.

The contractor shall ensure that operatives on site are familiar with the risk assessment and emergency procedures.

Adequate means of extinguishing fires as detailed in the hot work permit shall be provided by the contractor, to the approval of the Chief Fire Officer.

The contractor shall ensure that all site staff are adequately briefed and instructed on fire safety arrangements for the site and may be required to present proof.

All combustible materials shall be stored in a position and in a manner approved by the Chief Fire Officer.

Access for Emergency Services.

Areas should be set aside for the access of firefighting equipment or other like appliances including ambulances and shall be maintained; kept clear of obstructions at all times and marked/signed accordingly.

Hot Working

Hot working includes all types of welding work and any work involving naked flames or sparks.

Prior to any hot work being carried out by the contractor a correctly endorsed Hot Work permit shall be obtained from OAMC Authorized Personnel. The permit will carry endorsements as to the type of firefighting equipment to be provided by the contractor, and the authorizing person will enter the starting and completion times. Upon the completion of the work the permit must be returned to OAMC authorized Personnel for cancellation.

Site Welding

No welding shall be carried out in the site without prior approval from OAMC authorized Personnel that shall not be given until all conditions stipulated by the Hot Work permit have been met. The contractor shall give reasonable notice of his requirements to carry out welding on the site. All Welding work shall be done by Competent & authorized person only.

The contractor shall ensure that any welding operations are screened or carried out in such a way as to prevent the flashes from the process affecting any persons immediately adjacent to the operation, including any persons who have gained unauthorized access, from the effects of “arc eye”.

1.8 Hazardous Substances and Materials

General

The contractor shall ensure that risk assessments have been performed by a competent person for all the activities during the works and that written procedures for the handling, application, storage and disposal of hazardous products have been prepared.

The Project Manager/HSE HEAD/In charge of respective airports must be informed in writing of all substances intended for use on site which are classified as toxic, very toxic, corrosive, flammable, highly flammable or explosive

Design and Planning.

Where hazardous substances have been specified, the designer must evaluate to see if:

- A. They are strictly necessary for the process.
- B. They can be substituted for a safer alternative substance.
- C. An alternative method or process can be used to eliminate or reduce the hazard.

If it is not possible to adequately eliminate or control exposure to a hazardous substance then the contractor will need to ensure that suitable and sufficient personal protective equipment is provided to all affected employees and that they are adequately instructed on how, why and when it is to be used. The contractor must also consider the potential effects to other persons.

Hazardous Material Assessments.

1. A material assessment shall be carried out for every substance brought onto site,
2. When necessary, an operating procedure shall be produced for the safe handling,
Storage and use of a particular substance. A copy shall be given to the HSE Manager/HSE HEAD/In charge
3. All personnel shall be informed of any potential health hazards associated with any
Substance they may use or handle. The contractor shall ensure that correct use is made of the appropriate safety equipment provided by him.

4. All personnel shall have sight of the assessment that shall be available in the event of an incident that requires first aid medical treatment or firefighting.

Community Effects.

The contractor's materials risk assessment, selection procedure and exposure control measures must adequately consider the possible effects of products such as fumes, sprays or dust etc. both on and off the site. Examples would be the use of solvent-based paints and adhesives.

Handling.

1 After handling hazardous substances personnel shall wash their hands prior to eating, drinking and smoking.

2 Personnel shall not eat, drink or smoke in the proximity of stored hazardous Substances.

Explosives.

The use and or bringing of explosives on to site is **strictly forbidden**.

Waste Arising.

The contractor shall be responsible for the safe disposal of waste in accordance of the regulations followed by the company. Environment/Civil Defense Rules and Regulations arising from construction activities under his management and for ensuring that disposal is carried out as per the regulations.

Waste materials likely to present a hazard to site personnel shall be disposed of as soon as practicable or on the request of OAMC authorized Personnel.

The contractor shall be responsible for any damage or contamination caused by waste under his control and shall bear the full cost of any remedial measures that the responsible authorities or OAMC may direct.

1.9 Contractors General Machinery and Equipment.

The contractor shall ensure that employees are trained, competent and authorized to drive or

Operate any machinery or equipment that they may use, whether regularly or on an occasional basis. Training records should be maintained and may be requested by OAMC. Such equipment shall include, but not restricted to:

- Dumpers
- Forklift Trucks
- Lorries
- Hoists
- Cranes

- Excavators
- Mobile elevating work platforms
- Hand tools

Documentary evidence of such authorization shall be provided as required. Only training which is specific to the actual machine or equipment to be used will be considered acceptable.

All equipment provided shall be in good order and suitable for the use for which it is intended for. The contractor shall ensure that site machinery, equipment is inspected and thoroughly examined at regular intervals by person who are appropriately skilled and authorized to do so, and that records of such inspections/examinations are maintained in a register that may be available for examination by OAMC upon request. When selecting equipment the contractor shall take into account the working conditions and potential site hazards. All construction machinery shall be maintained in such a manner that smoke is not emitted.

All the Lifting Equipment must have valid test certificate (by third party agency means approved agency by Govt.) & should be submitted to HSE dept. prior to use.

1.10 Accident Treatment/Accident Reporting/First Aid Facilities.

The contractor shall provide adequate first aid facilities as may be required by OAMC.

Key personnel are to be properly trained and have a current training certificate. Trained first aid personnel should be clearly identifiable. First aid boxes should be clearly marked and regularly checked by the contractor.

The above first aid facilities are to be made available to all persons working on or visiting the site within 3 days of the start of project.

The contractor shall report all accidents to the Project Manager. All serious or potentially serious accidents/incidents are to be thoroughly investigated by the contractor and written reports produced indicating the proposed remedial actions. The contractor shall give a copy of all reports to OAMC and adhere to the Chief Executive Instruction No. 7 on **Reporting Procedure of accidents & Dangerous Occurrences** which is enclosed as **Annexure-6**

1.11 Abrasive Wheels.

The contractor shall take all necessary precautions to avoid the risk of fire due to flying sparks.

The contractor shall also ensure that no person in the area is exposed to the risk of eye or other injury from sparks, dust or other flying debris.

1.12 Excavations and Openings.

All excavations and openings shall be maintained with adequate structural support, access, egress, and provision of fences and handrails.

Lights shall be used to mark the edge of excavations and openings at night.

Services clearance must be obtained before any excavation commences.

Engineering Instruction EI/02 –Service Clearance and Permit to Dig attached as Annexure -5 must be followed in this regard.

1.13 Confined Spaces.

Contractors are responsible for the supply of all safety equipment including all portable gas detection devices, escape breathing apparatus, harnesses and other escape equipment and safety equipment must be in good order.

Contractors must be familiar with the system of clarification, the appropriate procedures that apply and follow a safe system of work in order that danger both to themselves and to others is avoided. The safe system of work must be reflected in their Method of statement & Risk Assessment. Necessary Coordination must be done with HSE HEAD/In Charge of respective Airports to carry out the job after fulfilling all the requirements laid down by HSE dept.

Contractor's staff who enter a confined space must be formally trained. The list of the Staffs who enters to the Confined Space must be given to HSE dept. Job to be done under close Supervision.

1.14 Electrical Equipment.

Contractors shall follow the OAMC **Electrical Safety Rules & procedures, Code of Practice** while working on any electrical system. For query related to electrical work must be contacted to Head of Electrical dept. OAMC.

Supplies to portable, electrical powered tools and temporary site lighting **must** be 110v. If 240 V is used provided it have an isolation mechanism in case of fault.

The contractor shall produce an electrical safety plan and ensure that only equipment designed for operating at the supply voltage is used on site. Where supplies greater than 110v have to be used the need must be fully justified, supported by a full method statement, before permission is obtained from the Project Manager. The tool shall be protected by an RCD and regularly checked and documented by a competent person.

The contractor shall ensure that all tools and distribution equipment including cables, plugs etc. are complete and examined for signs of damage or wear prior to use.

Trailing cables across operational or public areas are not permitted. Worn or damaged equipment shall not be used. Any non-compliant equipment found on site must be immediately removed. All 110v distribution equipment and cables, including lighting festoons must be routed and adequately supported to avoid creating hazards on site or damage to the cable or equipment.

1.15 Cranes, Hoists, Platforms etc.

The contractor shall ensure that all lifting equipment is of an approved type by third party (mean approved agency) and used in the approved manner. A current copy of the examination and insurance certificates shall be kept on site and made available to the HSEHEAD/ In charge upon request.

Each item of lifting equipment shall be marked with its safe working load (SWL), which shall not be exceeded, and with its unique identification marks. All lifting equipment shall be maintained in a safe condition and when not in use stored as safe as possible.

Any lifting equipment showing signs of wear or damage to safety critical parts shall be taken out of service immediately.

Only authorized slingers shall give approved signals to crane or machinery operators. The contractor shall ensure that the crane or machinery operator

accepts signals only from unauthorized slinger. The authorized slinger shall be readily identifiable.

Lifting tools & tackle, ropes etc. shall be of an approved type to the relevant Standard.

Any chain or strap etc. used for restraining load shall not be used if showing signs of wear or damage

The contractor shall ensure that any temporary platform shall be securely attached or fixed. It shall have handrails, intermediate guardrails and toe boards to prevent persons or materials falling from the platform. If the platform is attached to hydraulic or rope operated equipment then in the event of a hydraulic power failure a “fail safe device” shall be fitted to the item of equipment.

1.16 Working at Heights.

A safe working platform with secure edge protection, intermediate guardrails and safe means of access shall be installed. In instances where this cannot be, achieved alternative arrangements must be made to prevent persons or materials falling to the ground. Crawling boards and similar safety equipment shall be used on fragile roof surfaces.

Adequate containment measures shall be included to ensure that tools or materials cannot fall, or barriers are to be erected to keep people away from areas where overhead work is being carried out.

The contractor shall ensure that fixed scaffolds and mobile scaffold towers comply fully with all statutory requirements before and during use. Before starting the Height work, they must approach HSE dept. for inspection & approval to start the work.

1.17 Alcohol/Drug

No alcohol/drug shall be consumed by contractor's personnel at any time & at anywhere at site. Those persons reporting for duty and believed to be under the influence of alcohol shall be refused entry. It is the contractor's responsibility to

ensure all his employees are made aware of this requirement and to enforce compliance. Failure to comply with these requirements will result in the immediate removal of the offending employee from the contract and a warning letter will be issued after a thorough investigation. Repeated non-compliance with these requirements may lead to termination of the contract.

1.18 Smoking.

At Airside Smoking is strictly prohibited. In other area, Smoking is only permitted in authorized areas. **IF IN DOUBT - DO NOT SMOKE or approach the Project Manager for clarification.**

1.19 Safety Harnesses.

The contractor shall make safety harnesses and suitable training available for all employees who work where there is a risk of falling more than 6 feet (2 meters) and a safety barrier or cover cannot be practicably provided.

1.20 Non English Speaking Personnel.

The contractor shall ensure that all non-English speaking employees fully understand the site safety requirements and their duties covering safety, health and welfare while on site. This shall include any emergency procedures i.e. fire drill. The language needs of on English speaking personnel must be adequately catered for during induction, other training and supervision.

1.21 Testing, Commissioning and Maintenance of Temporary Equipment and Services.

As with all other aspects of construction and installation, work the contractor is required to conduct risk assessments and develop measures to eliminate or adequately control risks. The contractor shall appoint an authorized person who will be responsible when appropriate for issuing a permit to work prior to any commissioning or maintenance operations. The permit to work system will ensure that all operations follow a strict safe system of work.

Prior to any machinery, equipment or service being placed into use, the contractor shall ensure that the machinery, equipment or service is not used for purposes other than those it has been specifically designed for.

All moving machinery shall have an audible warning and flashlights that operates automatically when in reverse, and a flashing yellow hazard warning beacon.

The contractor shall provide a slinger whenever machinery or equipment is being moved near other personnel or there is a possibility of personnel being in the vicinity or when the operator does not have a clear view around his item of machinery or equipment.

1.22 Personal Protective Equipment.

The contractor shall ensure that risk assessments are carried out to identify those aspects of the work for which personal protective (PPE) is to be prescribed. The contractor shall select appropriate PPE to the work hazards identified. Adequate arrangements are to be made for the storage, cleaning, maintenance and replacement of PPE. Once a risk has been identified for which PPE has been prescribed and selected, the contractor must take all reasonably practicable steps to ensure that the relevant persons use it correctly. This will require the provision of information, instruction and training to staff.

Re assessment of all PPE provided should be made at regular intervals as methods of working or working conditions change to ensure that the appropriate PPE is being used.

1.23 Manual Handling.

Where manual handling operations may cause an injury at work. Prior to start the job a risk assessment shall be carried out.

1.24 Emergency Procedures.

The contractor shall ensure that emergency procedures are provided for the work site and that all staff understand their actions in the event of an emergency. All procedures must be cleared with OAMC to ensure that they do not conflict with Company arrangements. Emergency procedures must be reviewed and updated as major project works progress.

When calling Emergency Services the contractor is to follow the requirements of OAMC instructions. OAMC Airport Emergency Plan (AEP) to be followed in case of emergency.

1.25 Provision and use of Work Equipment.

The contractor shall ensure that all work equipment identified for use during the project including but not restricted to construction equipment is designed, selected, procured, used and maintained to enable the task to be safely completed.

The general requirements are that each employer must ensure that:

- Equipment is selected to be suitable for the intended purpose, particularly with regard to the site conditions in which the equipment will be used.

- Appropriate maintenance is carried out and any associated logs kept up to date.

- Specific Health and Safety risks associated with the equipment are considered and where appropriate:
 - Use of the equipment is restricted to competent, nominated persons.
 - Maintenance/Servicing is restricted to designated persons with the appropriate competence.

- Persons who will use, supervise and manage equipment receive information and instruction on training to cover
 - The conditions and circumstances in which the equipment may be safely used.

- The methods by which the equipment is to be used including operating procedures.
- Actions to be taken in the event of abnormal situations including emergencies.

1.26 Hygienic Maintenance.

It is most important for all contractors, especially those engaged in maintenance operations who may be required to work in areas where computing equipment is being handled, to recognize that the way they organize and conduct their work can present a threat to the product. The threat arises from several sources:

- A. Accidental contamination of the product or equipment by foreign bodies for example: flakes of paint, dust, nuts, bolts, screws, gaskets and “O” Rings etc.
- B. Accidental contamination by failure to operate according to a reasonable code of practical hygiene.
- C. Use of unsuitable materials to lubricate or otherwise treat the surfaces of Equipment.

It is therefore essential that due consideration is given to the way the work is to be done before starting, so that adequate precautions are taken to prevent contamination from all foreseeable sources. Also to be noted that FOD generated during the work must be cleaned by the contractor before leaving the site.

LIST OF ANNEXURES

Annexure – 1: OAMC Health, Safety & Environment Policy

Annexure – 2: CEI/ 06 – Procedure for Control of Contractors

Annexure – 3: OAMC Risk Assessment Procedure

Annexure – 4: Sample Risk Assessment Proforma

Annexure – 5: Engineering Instruction – EI/02: Service Clearance and Permit to Dig

Annexure – 6: Chief Executive Instruction –7: Reporting of Incidents/Accidents

Annexure-1

OAMC Health, Safety & Environment Policy



Health, Safety & Environment Policy

Oman Airports Management Co. is committed to being a leader in Health, Safety & Environment (HSE)	تلتزم الشركة العُمانية لإدارة المطارات بالسعي إلى تحقيق أفضل معدلات التفوق في مجالات الصحة والسلامة والبيئة.
Safety of our passengers, business partners, contractors, the general public and our employees is our number one priority. To achieve this objective, we will systematically assess and manage our HSE risks through an audited best practice of safety management system.	إن من أولويات العمل بالشركة هو سلامة وراحة المسافرين وعموم الجمهور ومرتادي مرافق المطار إلى جانب موظفي الشركات والقطاعات العاملة وكافة الشركاء والمتعاقدين، وفي سبيل تحقيق ذلك الهدف، فإن الشركة العُمانية لإدارة المطارات تسير وفق منهجية خاصة في إدارة وتقييم مخاطر الصحة والسلامة والبيئة في مقدمتها ضمان أفضل ممارسة لنظم إدارة السلامة.
Our Board of Directors and Chief Executive Officer fully support continuing development of Health, Safety and Environment culture within the Company by actively investing in people, facilities, equipment, procedures and making available all the resources to complement this policy, using a proactive HSE culture which will ensure that no activity is so important that it cannot be done safely.	يقوم مجلس إدارة الشركة ورئيسها التنفيذي على دعم وتطوير ثقافة الصحة والسلامة والبيئة في ممارسات العمل اليومي بالشركة ورفع مستويات الوعي للعاملين سواء كان ذلك من خلال الاستثمار السليم في الموارد البشرية والكفاءات البشرية أو في مستويات الجاهزية والاستعداد للموقف التنفيذي أو من خلال مراقبة ومتابعة أوجه القصور والنقص في ذلك والعمل على سده مباشرة من قبل المختصين.
Every manager shall be responsible for ensuring that adequate resources are made available to achieve this policy; while employees of OAMC and all partners are expected to support and be fully committed towards this policy's implementation. Specifically, Oman Airports Management Co. will	كل مسؤول يكون مسؤولاً عن ضمان وتوفير الموارد الكافية لتحقيق هذه السياسة ومن المتوقع من موظفي الشركة وجميع الشركاء الدعم والالتزام من أجل تنفيذ هذه السياسة.
<ul style="list-style-type: none">• Adopt a proactive approach to management of HSE• Comply with all national and international legislations• Periodically review our HSE policy and objectives and report on our performance against them• Utilize a risk based Safety Management System for effective monitoring and controlling of HSE performance, which necessitate of stopping any activities which hinder the safety of the people and the airports facility• Mitigate all HSE deficiencies identified through audits, inspections and occurrences investigations in a timely manner• Involve and consult our employees and partners in all stages of development , review and improvement of safety performance standards and procedures• Require all operations partners, stakeholders and contractors to demonstrate that their SMS is as good as or better than the system implemented by OAMC, and to assure this through audits, monitoring and assessment• Maintain effective contingency plans and ensure their efficiency and keep them updated in order to achieve the objectives of its existence	<ul style="list-style-type: none">• وفي ذات السياق، فإن الشركة العُمانية لإدارة المطارات تتطلع إلى تنفيذ ما سبق الإشارة إليه من خلال الآتي:• اعتماد الأنظمة الاستباقية الوقائية لإدارة الصحة والسلامة والبيئة• التأكيد على ضرورة مواكبة الأنظمة والبرامج الوطنية والدولية في ذات الاختصاص والمجال• المراجعة الدورية لأهداف وسياسات الصحة والسلامة والبيئة والعمل على ضمان بقائها ضمن مسارها المرسوم لها• الاستفادة من أنظمة تقييم المخاطر القائمة على مبدأ نظام إدارة السلامة في مراقبة الأداء والفعالية والكفاءة المهنية والعمل على وقف أي نشاط من شأنه أن يكون خطراً على سلامة الأفراد والمرافق العامة• المراقبة والتدقيق ومتابعة الحوادث والتحقيق فيها بشكل منهجي وموضوعي والعمل على سد وتخفيف أوجه القصور أو النقص، إن وجدت• تحقيق الشراكة مع جميع الأطراف العامة ضمن قطاعات المطار من خلال تبادل وجهات النظر في بناء مستويات الوعي الإداري والفني وتكامل الأنظمة وبرامج العمل المختلفة• العمل على متابعة التزام كافة الشركاء التجاريين والمتعاقدين بالأنظمة والبرامج المعتمدة وتنفيذها بشكل يجعل مخرجات الأداء في مستويات الاحترافية• ضمان وجود خطط طوارئ فعالة والتأكد من كفاءتها ومواكبتها لكافة المتغيرات الميدانية وتحديثها بما يحقق الأهداف المنشودة من وجودها
Aimen Bin Ahmed Al-Hosni Chief Executive Officer OAMC	أيمن بن أحمد الحوسني الرئيس التنفيذي

Annexure- 2

CHIEF EXECUTIVES INSTRUCTION

PROCEDURES FOR CONTROL OF CONTRACTORS	Ref No: CEI / 06 Date: 31/1/2003
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It is the responsibility of all employers to ensure that relevant CEI's are brought to the attention of their staff. However, individuals remain responsible for their own actions and those who are in any doubt should consult their supervisor or manager.

1. INTRODUCTION

- 1.1 The purpose of this document is to outline the basic safety rules and procedures designed to enable us to establish a method for controlling the activities of Contractors employed in any description of work at Muscat, Salalah & other Airports, and to ensure safe systems of work and safe working practices.
- 1.2 Oman Airports Management Company (OAMC) has a duty of care towards **all airport users** and conversely **all airport users** owe the same Duty of Care to protect OAMC staff from any dangers they may create.
- 1.3 It should not be construed that any amount of instructions, certificates or permits **alone** can provide the high standard of safety referred to without the reciprocating efforts of the Contractors.

2. SCOPE

- 2.1 These procedures shall apply to-

2.1.1 All contractors employed to carry out work at Muscat, Salalah & other Airports by OAMC, its tenants, concessionaires and their subcontractors.

2.1.2 All contractors employed to carry out work at Muscat, Salalah & other Airports by Statutory Authorities or Utilities.

3. CONTRACTORS DIRECTLY RESPONSIBLE TO AND SUPERVISED BY OMAN AIRPORTS MANAGEMENT COMPANY, AND CONTRACTORS EMPLOYED BY AND SUPERVISED BY GOVERNMENT AGENCIES, TENANTS AND THEIR CONCESSIONAIRES.

3.1 General

3.1.1 The Airport Maintenance Department or Technical Services dept. shall formulate and maintain a register of a select list of approved Contractors, which will be held by the General Manager of Technical Services or Sr. Maintenance Manager or his appointed representative.

3.1.2 To qualify for a place on the register, prospective contractors will be required to submit for examination the following:-

- Adequate information as may be requested by OAMC as proof of the company's financial status.
- The names of referees who can supply information regarding the type and approximate contract value of work that the company has recently carried out.
- Copies of the company's safety training records covering the last three years.
- The Safety Policy of the company and the name of the Contractor is Safety Officer or other manager who has responsibility for the safety function within the company.
- Where appropriate (e.g. for highly technical or hazardous work), the recruitment and training policies for staff carrying out the Contractor's work.

- Copies of the company's accident records covering the last three years.
- Details of any enforcement action taken against the company during the last three years.
- Contractor's will be responsible for ensuring the compliance of the terms of this document by any Sub-Contractors whom they employ.

3.1.3 For minor works by small companies where no formal safety policy documents or training records are available a formal letter indicating policy, past training and other relevant details covering the above headings should be forwarded for examination to the HSE Manager/HSE HEAD/In Charge or his appointed representative.

3.1.4 The Maintenance Manager or his appointed representative shall assess the above information and if found satisfactory, the name of the Contractor shall be entered in the approved Contractors Register.

3.1.5 This register shall be maintained for presenting for consideration a list of names of Contractors, who are known to have satisfied the foregoing initial qualifications, who may be considered for work on the airport.

3.1.6 Contractors who express an interest in carrying out work at the airport and who are not listed on the register can apply at the pre-tender stage.

3.1.7 The validity of the information shall lapse and require renewing after a maximum of 3 years, unless the circumstances require a more frequent renewal of information.

4. PERMITS TO WORK

4.1 A Permit to Work system shall be enforced for the following activities:

- Hot Works
- Confined Spaces
- Service Clearance and Permit to Dig
- Any Electrical Work
- Airside work authorization/permit

Prior to start the Confined Space & Electrical work contractor should take necessary precautions, which must satisfy the concern dept., and all the precautions taken must reflected in the method statement & Risk Assessment.

- 4.2 Prior to any excavation works being carried out a service clearance request shall be submitted, with details of the site location of the work to be undertaken to the Maintenance Manager for approval. Excavating work shall not proceed until the Maintenance Manager's written authorization has been given. The Maintenance Manager should consult with the Head of Airfield Operations and/or Airport Duty Manager for any work which will disrupt the normal operation at airside.

5. RESPONSIBILITIES

- 5.1 Managers who appoint contractors are to ensure that they are listed in the Approved Contractors Register, and it will be the responsibility of that manager to ensure all the required documentation is in place and that on completion of work a final examination should be carried out and a clearance report issued.
- 5.2 All Government Agencies, Tenants and Concessionaires, who intend to undertake any work by the use of Contractors or Sub-Contractors, or by their own direct Labour, must first obtain the approval of OAMC. They will be required to follow the same rules and procedures as detailed for contractors employed by OAMC.
- 5.3 The Supervising Manager shall inform the Head of Airport Operations or his authorized representative of the intended work to facilitate co-ordination of the works with any other programmed work and to identify hazards which might exist or be created within the areas of activity. This would apply to airside work.
- 5.4 The Supervising Manager shall be responsible for ensuring that any subsequent change in the works is examined for safety implications and that safeguarding measures are taken.
- 5.5 The Supervising Manager shall be responsible for ensuring such groups as may be affected at Muscat and Salalah International Airports are advised of the presence of Contractors working on site.
- 5.6 The Supervising Manager shall whenever possible ensure that the Contractors working area is separated off to form alternative premises under the exclusive control of the Contractor, his employees and their authorized visitors.

- 5.7 The Supervising Manager shall ensure the provisions of a safe means of access and egress for Contractor, Sub-Contractors, Suppliers, Agents or Visitors where, in order to reach their place of work, they have to pass through areas under OAMC control.
- 5.8 The Supervising Manager shall prior to the appointed Contractor commencing work on site hold a pre-start meeting with the Contractor's representative.
- 5.9 In the case of Term Contractors the pre-start briefing shall be held at the commencement of the contract. The Supervising Manager shall call any subsequent pre-start meeting prior to the commencement of any work not covered by the initial briefing or at his discretion
- 5.10 Where a Contractor is frequently employed for minor works he must be made aware, by the Supervising Manager, of any changes to the initial briefing prior to start of work. A Minor Works Registration Form is to be completed and filed in the Contracts Register.

6. PRE-START CONTRACT MEETING

- 6.1 Prior to the contractor commencing work on site he shall be briefed regarding the following:-
- OAMC Health, Safety & Environment Policy
 - OAMC Safety Requirements for Contractors
 - OAMC Procedures governing the issue of Permits to Work
 - Muscat, Salalah & other Airports security arrangements
 - Emergency procedures for calling emergency services
 - Access & Job Registration form.
 - Fire & Safety Standards
 - Specific site restrictions & hazards
 - Company policy documents and safe working practices with which he must comply and to discuss and record the specific contract particulars and other site matters relating to the work he is about to undertake
 - The Contractors Job Registration Form must also be completed
- 6.2 Relevant matters to be agreed should include-
- Date of possession of site and completion of the works
 - Description of works and phasing

- Programme of works
- Health & Safety matters
- Names of Contractor's or Sub Contractor's key personnel
- The completion of the Contractors Job Registration form
- Security clearance procedures and instructions (R.O.P.)
- Communications
- Emergency contact names and telephone numbers

6.3 Site Matters

- Site plans, site boundary and restrictions
- Site access
- Records of existing site services
- Public Utilities
 - Water
 - Electricity
 - Telecommunications
- Contractor's Signboards
- Contractor's Working Agreement
- Permits to Work
- Site Clearance Request Procedures

6.4 On completion of pre start meeting the contractor will be required to sign the form for carrying out the job safely & follow all the rules and regulations.

6.5 The Supervising Manager will regularly monitor the work in progress to ensure that all safety requirements and standards are being met.

6.6 On completion of the job the Supervising manager responsible for the contract shall inspect the works and when satisfied with the result shall comment in writing

7 ENQUIRIES

1.1 Any enquiries related to this instruction must addressed to HSE Manager
Telephone: 24341066

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Chief Executive Officer

Annexure-3

Risk Assessment Procedure

Contents

- 1. Introduction**
- 2. Scope**
- 3. Definitions**
- 4. Responsibilities**
- 5. Risk Assessment Procedure**
- 6. Attachments**

Appendix-A Hazard Identification Checklist Tables

Appendix-B Control Measures Guidance

1. Introduction

Risk assessment is a qualitative method of assessing the risks associated with a particular job, activity or task in order to identify the control and contingency measures that should be taken to manage the risks. This procedure provides a framework for conducting risk assessments.

In this procedure, the emphasis is placed on the risks to people, the approach can also be applied to the assessment and management of environmental, asset and other risks associated with work activities with suitable modification of the judgement criteria.

2. Scope

This document is applicable to OAMC activities, including project activities.

3. Definitions

As Low As reasonably Practicable (ALARP), is determined when it can be shown that no more measures can reasonably be taken in order to reduce the risks further.

A hazard is an article, substance or situation that has the potential to cause harm. This can include materials, machines, methods of work and other aspects of work organisations.

A risk is the likelihood that the harm from a particular hazard will be realized.

Where the :Likelihood is the description of how often an event will occur in terms of occasions per period of time and is usually based on historical data and statistics. Consequence is a description of how bad and how severe the event might be.

4. Responsibilities

Line Managers are responsible for ensuring hazards are identified, the associated risk assessed and suitable control measures implemented.

5. Risk Assessment Procedure

This procedure is intended to help OAMC and their employees, stakeholders, Contractors to assess risks in the workplace. The process is started by identifying hazards, then by evaluating the risks arising from those hazards and finally by taking necessary measures to reduce the risks to persons to the lowest level that is reasonably practicable (ALARP).

5.1 Risk Assessment Process

The risk assessment process consists of five essential steps. Each step of the assessment process should be completed before going onto the next.

Step 1 - Look for the Hazards

Look for what could reasonably be expected to cause harm. Ignore the trivial and concentrate only on significant hazards, which could result in serious harm or affect several people by considering the equipment and materials being used and the environment where the work is being carried out. Manufacturer instructions or material datasheets can also help you stop hazards and put risks in their true perspective.

Step 2 - Decide who may be harmed and how

Think about people who may not be at the work place at the time, e.g. cleaner, visitors, contractors, and members of the public, etc. Is there any chance that they might be harmed by your activities?

Step 3 -Evaluate the risks arising from the hazards and decide whether existing precautions are adequate or more should be done

Risks can be reduced by using the following hierarchy:

- Eliminate the hazard to remove the risk; e.g. use of intrinsically safe electrical equipment in a classified area (elimination of sparks, which are ignition sources).
- Reduce or substitute the hazard with an alternative; e.g. use of sodium hypochlorite solution instead of free chlorine gas for disinfection purposes.
- Isolate the hazard from people; e.g. fencing of excavations.
- Control the hazard by introducing suitable measures; e.g. Permit-to-Work system.
- Personal protective equipment; e.g. use of safety harness when working at height.
- Discipline - personal discipline which is competence based (e.g. discipline which is rule based (e.g. adherence to work procedures).

Step 4 - Record

Record the findings, write down the more significant hazards e.g. above ground power cables.

Step 5 - Monitor and Review

Review your assessment from time to time and revise if necessary. If there is any significant change, you should add to the assessment to take account of the new hazards.

5.2 Conducting a Risk Assessment

Risk assessments can be conducted using the blank Risk Assessment Proforma .

Stage (1): Define Tasks, Activities

This is the starting point for the risk assessment and requires consideration of all the tasks that are likely to be carried out and the workplace area. In order to adequately assess the risk associated with the task, a manageable level of detail is required and this may require the task to be broken down into discrete steps or component tasks.

Each of these tasks is then defined in terms of activities, use of plant and equipment, use of materials/substances, workplace and procedures used.

The method proposed for identifying the tasks is to categorise the tasks according to the lead job trade/discipline involved in carrying out the work. This should help to build up (over time) an inventory of tasks that the lead discipline get involved in and the type of work carried out in the different workplace areas. Once all the tasks have been identified, an inventory should be drawn up which lists all the lead disciplines and the tasks carried out in each workplace area. These tasks can be considered as being routine or generic and these should be fed forward for risk assessment.

Stage (2) : Identify Hazards

In order to improve consistency in identification of hazards and to ensure that no hazards are omitted at this stage,

it is proposed that personnel engaged in risk assessment use the hazard identification checklist tables provided in

Appendix-A.

The checklist given is not exhaustive and should be updated each time a new hazard is identified. The checklists can be used as a guide to ensure that personnel involved in the risk assessment are not side-tracked into identifying things as hazards that are not in fact hazards. (For example, failure to wear a safety helmet is not a hazard, it is dropped objects from above or impacts that are the hazards. Not wearing a safety helmet is a failure to comply with a control measure and is a factor that should be taken into account when assessing risk). This can waste time and results in a failure to address the real issues and hence to consider the proper control measures.

The checklist tables provide examples of hazards within the following categories:-

- i) Plant and Equipment
- ii) Materials and Substances
- iii) Place of Work
- iv) Working Environment
- v) Methods of Work

Other methods that can aid hazard identification include the use of accident /incident statistics, toolbox talks etc.

Stage (3): Identify Hazard Effects on People

Having identified the hazards, the next step is to identify the people who are at risk from each hazard and its effect(s) on them. In most cases, those affected will be the persons involved in the tasks. In other cases it may be other personnel not directly involved with the task e.g. cleaners, neighbors, visitors etc.

Risk Assessment

Stage (4): Estimate Consequence (Severity) Rating

The judgement about the consequence (severity) rating of the hazard, with or without any control measures in place, should be entered on the Risk Assessment form as a number using the following scale shown in Table 1 for Injury.

The consequence ratings for environment and asset damage are shown for completeness and may not be relevant as far as risk assessment for personnel

Table 1 - Consequence (Severity) Rating Guidance

Level		Description
1	Insignificant	No injuries, low financial loss
2	Minor	First aid treatment required, on site release immediately contained, medium financial loss.
3	Moderate	Medical treatment required, on site release contained with outside assistance, high financial loss
4	Major	Extensive injuries, loss of production capability, off site release with no detrimental effects,

		major financial loss
5	Catastrophic	Death, toxic release off-site with detrimental effect, huge financial loss.

The person(s) carrying out the risk assessment should not become too obsessed with the figures; part of the purpose of the risk assessment is to identify the control measures that need to be implemented and these qualitative figures are designed to assist with the prioritization of such measures. The objective of this process is not to arrive at a certain number but to provide a systematic method of ensuring that consequence and likelihood ratings are analyzed carefully and a record made of the analysis for future reference and review.

Stage (5) : Estimate Likelihood Rating

The judgement regarding the likelihood of the hazard actually causing harm is more difficult than deciding on the consequence of the hazard. Typical factors affecting the analysis of likelihood are:-

- a) The number of times the situation occurs;
- b) Duration of exposure;
- c) Quantities of materials involved;
- d) Environmental conditions;
- e) Competence of people involved;
- f) Condition of equipment;
- g) Lighting;
- h) Distractions.

The other important factors to take into account are the control measures already provided or to be provided. In analyzing the likelihood of harm, the risk assessor(s) must take into account the possibility of control measures not being implemented due to human error, lack of maintenance, difficulty in compliance, complexity of instructions, etc. It is essential to discover how the task is actually

carried out and base the assessment on this, rather than assessing the likelihood on how the task is supposed to be carried out. When all factors have been considered and a decision made on the likelihood of the hazard actually causing harm, a number can be entered in the *Likelihood* column on the risk assessment form using the scale shown in Table 2.

Table 2 - Likelihood Rating Guidance

Level		Description
A	Certain	Is expected to occur in most circumstances.
B	Likely	Will probably occur at some time.
C	Possible	Might occur at some time.
D	Unlikely	Could occur at some time.
E	Rare	May occur only in exceptional circumstances.

Stage (6) : Analyze Risk Rating

Risk Rating Without Any Control Measures

The next stage is to arrive at a risk rating (or ranking) for each hazard . This produces a risk level that should be entered in the *Risk* column on the Risk Assessment Form. The rating in the *Risk* column provide an indication of priority and of the extent of the risk without any specific control measures.

Risk Rating Matrix

Risk Rating

	<i>Insignificant</i>	Minor	Moderate	Major	Catastrophic
<i>Likelihood</i>	<i>1</i>	<i>2</i>	<i>3</i>	<i>4</i>	<i>5</i>
1 A (certain)	<i>H</i>	<i>H</i>	<i>E</i>	<i>E</i>	<i>E</i>
2 B(likely)	<i>M</i>	<i>H</i>	<i>H</i>	<i>E</i>	<i>E</i>
C (moderate)	<i>L</i>	<i>M</i>	<i>H</i>	<i>E</i>	<i>E</i>
4 D (unlikely)	<i>L</i>	<i>L</i>	<i>M</i>	<i>H</i>	<i>E</i>
5 E (rare	<i>L</i>	<i>L</i>	<i>M</i>	<i>H</i>	<i>H</i>

<i>KEY</i>		
<i>E</i>	Extreme Risk	Attention and immediate intervention at CEO level is required. Operations should not continue until it is demonstrated that the risk is significantly reduced.
<i>H</i>	High Risk	Director's attention and rectification required. Multiple levels of safety controls must ensure safety in the event of a single safety control failure.
<i>M</i>	Moderate Risk	Ongoing responsibility is allocated to an accountable Manager and monitored/audited through quality assurance processes. Safety controls are evaluated and documented.
<i>L</i>	Low Risk	Line Management are required to monitor activities, ensuring the level of risk remains as low as reasonably practicable. Regular documented workplace inspections/audit required

Control Measures

The next step is to consider the preventative and/or protective control measures needed to reduce or minimize the risk for each identified hazard. The preferred hierarchy for the control measures should be as follows:-

- a) Elimination or minimization of hazard;
- b) Engineering design;
- c) Suitable systems of working - procedures, competency, training etc.;
- d) Provision of suitable personal protective equipment.

The control measures may address the consequence, the likelihood or both. The required control measures for each hazard should be recorded alongside each hazard on the Risk Assessment Form. Appendix B provides guidance on the type of control measures that can be employed for the various hazards. Residual Risk

To assess the Residual Risk that remains with the control measures in place, the consequence and likelihood ratings are again selected from the scales shown in Tables 1 and 2, respectively.

Stage (7) : Risk Evaluation

The risk rating is evaluated again from Table 3. The information provided in the Residual Risk box (with control Measures) is used in the next stage of the Risk Assessment to evaluate whether the risk is adequately controlled or not.

This is the final step in the risk assessment process and will require the assessor(s) to decide if the hazards identified have been controlled to a suitable level. The risk analysis stage took into account the control measures currently applied to the hazard and, therefore, the result of the analysis indicates the amount of risk that remains, or the *residual risk*. The system used in this section will use this analysis to decide if the residual risk of each hazard is:-

- a) Low Risk
- b) Moderate Risk
- c) High Risk
- d) Extreme Risk

After this any other control measure required to be put in place to further reduce the risk is entered in the next column and the responsibility for that particular risk management is also fixed and documented.

These results are recorded in the final column of the risk assessment form.

Table 4 - The Severity/Likelihood Matrix shows the result of the risk analysis of severity and likelihood and gives a rough guide to the size of the risk.

In general, high risks may require the provision of considerable additional resources involving special equipment, training, high levels of supervision, and consideration of the most effective methods of eliminating or controlling hazards. Lower level risks may be considered as acceptable but actions should still be taken to try to reduce these risks further if possible within reasonable limits.

Table 4 Severity/Likelihood Matrix

Risk Response Matrix					
Likelihood	Consequences				
	1. Insignificant	2. Minor	3. Moderate	4. Major	5. Catastrophic
A Almost certain	(improvement required in the short term)		Intolerable (urgent action required)		
B Likely					
C Possible					
D Unlikely	Tolerable (low risk priority)		Must consider measures to reduce risk	to risk (assess & monitor regularly)	
E Rare					
<div>Risk Level: ● Extreme ● High ● Moderate ● Low</div>					

Attachments

Appendix-A Hazard Check list – 1 to 7

Appendix-B Control Measures Guidance

Appendix-A Hazard Checklist – 1

Hazards associated with plant and equipment (including non-powered plant and hand tools)

Category	Type of Harm	Examples of Hazards
Mechanical	Trapping - Crushing - Drawing-in - Shearing	Two moving parts or one moving part and a fixed surface Belt and drive Pulley Hydraulic ram "In-running nips" Mangle Scissors Hammer
	Impact - Striking - Stabbing - Puncturing	Something that may strike or stab someone or can be struck against Moving vehicle/cart/trolley Drill Hypodermic needle Crane hook
	Contact Something sharp or with a rough surface - Cutting Knife, chisel, saw, etc. - Friction Blender blade - Abrasion	Something sharp or with a rough surface - Cutting Knife, chisel, saw, etc. - Friction Blender blade - Abrasion Circular saw blade Sanding belt or Abrasive wheel
	Entanglement	Rotating parts Drill chuck and bit Power take off shaft Pipe threading machine Abrasive wheel
	Ejection	Work piece or part of tool Cartridge tool (e.g. rivet gun, grease gun) Mixing machine Using hammer and chisel Abrasive wheel
Electrical	Shock/Burn/ Fire/Explosion Ignition sources	Electricity above 240v Electricity - 240v Electricity - 110v Extra low volt electricity Static Batteries
Pressure	Release of energy - Explosion - Injection - Implosion	Compressed gas (e.g. air, bottled gas) Process streams (e.g. gas, condensate, crude oil) Utility streams (e.g. glycol, heating medium) Boiler Vacuum Hydraulic system
Thermal	Burns Fires Scalds Frostbite	Hot / cold surface Blow lamp Welding flame/arc Refrigerant Steam
Radiation	Ionising - Burns - Cancers - Blood disorders X Rays Alpha or Beta Rays Naturally occurring radioactive material LSA	X Rays Alpha or Beta Rays Naturally occurring radioactive material LSA - Sickness Neutrons Non-ionising - Burns - Melanomas

	<ul style="list-style-type: none"> - Sickness Neutrons - Non-ionising - Burns - Melanomas - Micro wave - Radio frequency - Laser - Cataracts Ultra violet - Static shock Infra red - Induced body Electromagnetic (transformers, power cables) currents 	<ul style="list-style-type: none"> - Micro wave - Radio frequency - Laser - Cataracts Ultra violet - Static shock Infra red - Induced body Electromagnetic (transformers, power cables)
Noise	<ul style="list-style-type: none"> - Hearing loss - Deafness - Tinnitus 	<ul style="list-style-type: none"> - Machine tools/equipment - Hand tools - Pneumatic tools/equipment
Vibration	<ul style="list-style-type: none"> - Vibration white finger - Whole body effects - Circulatory disorders 	<ul style="list-style-type: none"> - Pneumatic drill - Operation of machinery
Overload/defective due to mechanical failure	<ul style="list-style-type: none"> - Crushing 	<ul style="list-style-type: none"> - Crane overload - Chain sling - Eye bolt overload - Scaffold overload - Lifeboat pendant
Display screen Equipment	<ul style="list-style-type: none"> - Eyestrain - Headaches - Muscular discomfort - Work related upper limb disorders 	<ul style="list-style-type: none"> - Poor layout of work station - Poor furniture - Poorly sited screens - Illegible text

Hazard Checklist - 2
Hazards associated with materials and substances

Category	Type of Harm	Examples of Hazards
Fire/Explosion Combustion	Burns	<ul style="list-style-type: none"> - Timber stack (e.g. scaffold board store) - Paper store - Grease - Oily rags - Plastic foam
Flammable substances	Burns	<ul style="list-style-type: none"> - Hydrocarbon gases, condensate, oils - Bottled hydrocarbon gases (e.g. acetylene) - Lubricants - Diesel - Methanol - Paint/thinners/solvents - Hydrogen (e.g. battery room) - Aromatic hydrocarbons (benzene, toluene, etc)
Oxidizing Substances	Burns	<ul style="list-style-type: none"> - Explosive material - Pyrotechnics (e.g. lifeboat flares) - Detonators
Health Hazards Toxic Material	<ul style="list-style-type: none"> - Acute :- respiratory irritation - chemical asphyxiation - nervous system effects - narcotic effects - damage to eye - Chronic :- Anaemia - Leukaemia 	<ul style="list-style-type: none"> - Hydrogen Sulphide - Benzene - Methanol - Isocyanates - Corrosion Inhibitors - Dust - Paints - Degreasing Solvents - Anaerobic sealants - Primers

Corrosive Material	Acute :- - skin, eye, respiratory irritation - burns Sulphuric acid Caustic soda Hydrochloric acid Bleaches - ulceration - tissue destruction	Sulphuric acid Caustic soda Hydrochloric acid Bleaches
Irritant Material	Acute :Man made mineral fiber - skin, eye and respiratory irritant - dermatitis	Man made mineral fibre - skin, eye and respiratory irritant - dermatitis Cement Dust Sodium hypochlorite
Sensitizing Materials	Acute - respiratory and skin allergic reactions after sensitization	Isocyanates Glutaraldehyde (biocide) Terpene Welding/soldering fumes
Possible Carcinogens	Chronic : - skin, lung cancers - asbestosis, mesothelioma - dermatitis	Asbestos Polyromantic hydrocarbons Used engine oil
Asphyxiants	Acute and chronic effects on health	Nitrogen Carbon dioxide Argon
Biological	Acute :- Legionnaires disease - gastrointestinal disorders - food poisoning - asthma	Bacterial Viral Fungal Biological dusts (flour, hardwood)
Contact	Cuts, abrasions Burns, frostbite	Swarf Rough timber Concrete blocks Molten metal Frozen food

Hazard Checklist - 3
Hazards associated with place of work

Category	Type of Harm	Examples of Hazards
Access/Egress	Access/Egress	Damaged floors Trailing cables Oil spills Water on floors Debris Sloping surface Uneven steps Changes in floor level
Work at height	Falls	Fragile roof Edge of roof Edge of mezzanine floor Work on ladder Erecting scaffold Hole in floor
Obstructions	Striking against	Low headroom

		Sharp projections
Work over/near liquids	Fall into substances - Drowning - poisoning - suffocation	Fall into substances - Drowning - poisoning - suffocation
Emergencies	Trapping in fire	Locked exits Obstructed egresses Long exit route
Transport	Fatality, injury	Motor vehicle Air Marine Pedestrian
Natural Hazards	Injury Illness	Lighting Flash flood

Hazard Checklist - 4
Hazards associated with the working Environment

Category	Type of Harm	Examples of Hazards
Light (NB : also increases risk of contact with other hazards)	Eye strain Arc eye Cataracts	Glare Poor lighting Stroboscopic effect Arc welding Molten metal
Temperature	Heat stress Hypothermia Heat stress Work in furnace Cold room Outdoor work Sunburn Hot weather Melanoma Cold weather Hypothermia	Work in furnace Cold room Outdoor work Sunburn Hot weather Melanoma Cold weather Hypothermia Wind chill factor Work in rain, snow, etc.
Noise	Hearing loss Ambient Noise > 85 dB(A) Deafness Machinery noise Tinnitus	Ambient Noise > 85 dB(A) Deafness Machinery noise Tinnitus Relief valve noise
Confined space	Asphyxiation	Work in tank Chimney Unventilated room Vessel Silo
Ventilation	"Sick Building Syndrome" Fumes Nausea Odours Tiredness	Fumes Nausea Odours Tiredness Tobacco smoke

Hazard Checklist - 5
Hazards associated with the Method of work

Category	Type of Harm	Examples of Hazards
Manual Handling	Back injury Hernia	Lifting Lowering Carrying Pushing Pulling Hot / Cold Loads Rough Loads Live Loads - Animal / Person
Repetitive Movement	Work related upper limb disorders	Keyboard work Using screwdriver Using hammer and chisel Production line tasks
Posture	Muscle strains/ sprains Back pains	Seated work Work above head height

	Work related upper limb disorders Stress	Work with display screen equipment Work at floor level
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Hazard Checklist - 6
Hazards associated with work organization

Category	Type of Harm	Examples of Hazards
Contractors	Injuries and ill health to employees by contractors work Injuries and ill health to contractors' employees by work in premises	Work above employees Use of harmful substances Contractors welding Process fumes Services (e.g. underground electricity cables) Stored hazardous materials
Organization of work	Injuries to employees	Monotonous work or Stress Too much work Lack of control of job - lack of supervision - lack of information - lack of instruction - lack of training - inadequate monitoring Work too demanding/high work rate Communication Provision of unsuitable equipment
work in public areas	Injuries and ill health of Public	Trailing cables Traffic/plant movement Obstructions to pedestrians Work above public

Hazard Checklist - 7
Hazards - Other Types

Category	Type of Harm	Examples of Hazards
Attack by animal	Bite Sting Crushing	Bees Dog Scorpion Fleas Snake
Attack by people	Injury Illness Post trauma stress Disorder	Criminal attack Angry customer Drunken person Drug abuser Mentally ill person

Appendix-B
Control Measures Guidance

Contents

1. Health Hazards
2. Falling/Swinging/Dropping Loads
3. Electricity
4. Vibration/Noise
5. Emergency
6. Equipment Failure
7. Machinery/Equipment
8. Explosion

9. Fire
10. Human Error
11. Entry into Confined Space
12. Pressure
13. Ionizing Radiation
14. Slip/Trip/Fall

Control Measures for Health Hazards

1. Atmospheric Monitoring
2. Barrier Cream
3. Breathing Apparatus
4. Detailed COSHH Assessment
5. Enclosure/Segregation of Contaminant
6. Ergonomic Assessment
7. Forced Extract Ventilation
8. Information
9. Instruction
10. Local Exhaust Ventilation
11. Manual Handling Assessment
12. Medical Surveillance/Screening
13. Minimized Fume/Dust/Vapor Production
14. Natural Ventilation
15. Protective Clothing
16. Regular Cleaning/Decontamination
17. Respiratory Protective Equipment
18. Restricted Workplace Eating/Drinking/Smoking
19. Restricted/Controlled Access to Working Area
20. Substituted Safer Material
21. Supervision
22. Training

Control Measures for Falling/Swinging/Dropping Loads

1. Additional Suspension/Support Devices
2. Adequate Lighting
3. Banksman
4. Bumper Protection
5. Competent Lifting Operation
6. Competent Rigging
7. Failure Mode Effect Analysis (FMEA)
8. Fall Restraint Device
9. Load Monitoring
10. Maintenance Programme
11. Movement Restraint Device
12. Overhead Protection
13. Overload Warning System
14. Periodic Examination/Testing/Inspection
15. General Issue Personal Protective Equipment
16. Relocation of Vulnerable Equipment/Depressurization
17. Restricted Access to Safe Distances
18. Safety Watch
19. Warning Notices

Control Measures for Electricity

1. Anti-static
2. Classification of Hazardous Areas (Flammable Gases and Vapors)
3. Earth Monitoring
4. Equipment and Fittings Constructed, Installed and Maintained for
5. Atmospheres
6. Fusing
7. Insulation
8. Isolating Transformer
9. Isolation
10. Phase Separation
11. Residual Current Device
12. Permit to Work/Limitation of Access
13. Shielding

14. Voltage Reduction
15. Work Carried Out by Competent Person/s

Control Measures for Vibration/Noise

1. Audiometry
2. Design Out Noise from Equipment
3. Design Out Noise from Task
4. Detailed Noise Assessment
5. Enclose Noisy Equipment
6. Engineering Controls
7. Hearing Protection Zone
8. Noise Exposure Monitoring
9. Noise Survey
10. Restricted Access to Noisy Areas
11. Selection and use of Appropriate Hearing Protectors
12. Warning Signs
13. Work Patterns e.g.: Defined Spells of Exposure

Control Measures for Emergency

1. Adequate Planning
2. Competent Person/s in Charge
3. Platform PA and Alarm System
4. Emergency Response Procedures
5. Drills/Exercises/Training
6. Provision of Adequate EER Facilities

Control Measures for Equipment Failure

1. Appropriate Materials (Fit for Purpose)
2. Certified Equipment/Materials
3. Design Diversity
4. Design Redundancy
5. Failure Mode Effects Analysis
6. Fault Tree Analysis
7. HAZOP
8. Planned Preventative Maintenance Programme
9. Operational Monitoring
10. Regular Inspection/Testing

Control Measures for Machinery/Equipment

1. Control System Interlocked Guarding
2. Emergency Stop Device
3. Fixed Guarding
4. Planned Preventative Maintenance Programme
5. Mechanical and Electrical Isolation
6. Permit to Work System
7. General Issue Protective Equipment
8. Warning Signs/Notices

Control Measures for Explosion

- 1) Electrical Equipment and Fittings Constructed, Installed and Maintained in Accordance with BS5345
- 2) Blast Wall/Enclosure
- 3) Deluge on Confirmed Gas Detection
- 4) Earthling/Earth Monitoring
- 5) Exclusion of Ignition Sources
- 6) Explosion Venting/Relief
- 7) Inert Gas Blanketing
- 8) Leak/Spillage Detection - Portable Gas Monitor
- 9) Leak/Spillage Detection - Gas Detection System
- 10) Purging
- 11) Security of Access to Explosive Materials
- 12) Permit to Work System
- 13) Use of Non-Sparking Tools
- 14) Safety/Fire Watch

Control Measures for Fire

- 1) Automatic Fire Doors
- 2) Classification of Hazardous Areas Ref. BS5345
- 3) Containment/Segregation of Flammable Materials

- 4) Emergency Shut Down System
- 5) Exclusion of Ignition Sources
- 6) Exclusion of Oxygen Sources
- 7) Fire Extinguishing Protection Systems - Fire, Water, CO₂, and Halon
- 8) Passive Fire Protection
- 9) Fire Watch
- 10) Fire and Gas Detection System
- 11) Depressurization/Blowdown System
- 12) Inspection/Certification of Premises
- 13) Self-Closing Fire Doors
- 14) Portable Fire Extinguishers
- 15) Portable Gas Monitors
- 16) Use of Fire Blankets
- 17) Permit to Work System

Control Measures for Human Error

- 1) Adequate Rest Periods
- 2) Audit Performance
- 3) Defined Competence Level
- 4) Defined Performance Standard
- 5) Defined Responsibilities
- 6) Adequate Information
- 7) Adequate Instruction
- 8) Adequate Supervision
- 9) Adequate Training

11. Control Measures for Entry into Confined Space

- 1) Atmospheric Monitoring of Confined Space
- 2) Breathing Apparatus
- 3) Lifeline
- 4) Safety Watch
- 5) Forced Ventilation
- 6) Natural Ventilation
- 7) Equipment Positively Isolated (Mechanical/Electrical)
- 8) Adequate Lighting
- 9) Safe Access/Egress
- 10) Permit To Work System

Control Measures for Pressure

- 1) Appropriate Design/Construction Materials
- 2) Barriers at Safe Distance
- 3) Certified Equipment/Materials
- 4) Periodic Inspection/Testing Examination
- 5) Pressure Monitoring
- 6) Overpressure Protection e.g.: PSV, Bursting Disc
- 7) Safe Working Pressure Specification

Control Measures for Ionizing Radiation

- 1) Competent Personnel
- 2) Dose Monitoring
- 3) Health Surveillance
- 4) Local Rules
- 5) Personal Protective Equipment
- 6) Adequate Training
- 7) Appointed Radiation Protection Supervisor
- 8) Permit to Work System
- 9) Warning Signs
- 10) Area Cordoned Off (Three Dimensionally)
- 11) Non-essential Personnel Cleared
- 12) PA Announcements

Control Measures for Slip/Trip/Fall

- 1) Adequate Lighting
- 2) Appropriate Footwear
- 3) Openings Covered
- 4) Edge Protection/Rails/Barriers
- 5) Fixed Platform/Ladder
- 6) Good Housekeeping

- 7) Harness, Line and Attachment
- 8) Non-slip Surface
- 9) Periodic Cleaning
- 10) Periodic Inspection
- 11) General Issue Personal Protective Equipment
- 12) Warning Notices

Annexure-4

Sample Risk Assessment Proforma

Document Title: Revision: 1	Oman Airports Management Company Safety Management System Risk Assessment	
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No.	HAZARD	RISK DESCRIPTI ON (THE RISK – WHAT CAN HAPPEN AND HOW IT CAN HAPPEN)	EFFECT	RISK ANALYSIS (NO CONTROLS)			CONTROL MEASURES	RISK ANALYSIS (WITH CONTROLS)			FURTHER ACTIONS TO REDUCE RISK	RESPONSIBILITY
				CON SEQUEN CE	LIKE LIHO OD	RISK LEVEL		CONSE QUEN CE	LIKEL IHOO D	RISK LEVEL		
1												
2												
3												

ANNEXURE -5

ENGINEERING INSTRUCTION

Ref No: EI / 02

SERVICE CLEARANCE AND PERMIT TO DIG

Date: 3/2/2003

It is the responsibility of all employers to ensure that relevant E.I.'s are brought to the attention of their staff. However, individuals remain responsible for their own actions and those who are in any doubt

1. INTRODUCTION

In order to protect existing services at Muscat, Salalah & other Airports, comply with Health, Safety & Environment Policy, Procedures, the requirements of Statutory Undertakings, and other bodies, **all works** involving excavations into the ground require prior notification and the completion/issue of:

- a. Services Clearance Certificate
- b. Permit to Dig.
- c. Permission to open (for landside roads, footpaths and verges, see para3.4)

This Engineering Instruction is broken into two parts:

Part 1 Procedure for obtaining a Services Clearance Certificate

Part 2 Procedure for obtaining a Permit to Dig.

Requests for Services Clearances Certificates and Permits to Dig should be processed by the 'OAMC Authorised Person'.

All parties involved in the works requiring a Service Clearance and Permit to Dig, should be made aware of the existence of 'uncharted services' at Muscat and Salalah. The OAMC Authorised Person should take all steps reasonably practicable to ensure a safe environment for those working or visiting the site and that there is no disruption to the effective operation of the Airport or its users.

2. DEFINITION

The OAMC Authorised Person varies according to the type of work or project being undertaken. The following list identifies the OAMC Authorised Person for the various situations. This is not an exclusive list and as circumstances change further job roles can be added, with the permission of the Maintenance Manager Tel 24341400

PROJECT TYPE	OAMC AUTHORISED PERSON
Maintenance Works	OAMC Maintenance Manager/MDM91
Traditional Project Works	OAMC Project Manager
Construction Management / Development Project	OAMC Development /Maintenance Manager
Works by DGCAR	OAMC Development Manager / Maintenance Manager
Works by O.A. & Other Airport User Groups	OAMC Development Manager / Maintenance Manager
Works by Commercial / Retail / Tenants	OAMC Commercial Manager
Works by Ministry of Electricity & Water	OAMC Maintenance Manager
Works by External Electrical Contractors	Contractors Project Manager
Works by External Civil Contractors	Contractors Project Manager

Where the works by Contractors have been instructed by OAMC, it is the responsibility of the OAMC employed Engineer to check that the OAMC Authorised Person working for the Contractor has obtained the necessary Service Clearance Certificate and Permit to Dig.

3. PART 1: PROCEDURE FOR OBTAINING A SERVICE CLEARANCE CERTIFICATE

- 3.1** The first step must be to undertake a desktop survey. This should include contacting the OAMC Maintenance Data Office on Tel: **91425374**/for copies of the latest service drawings for the area in question. This information must be used as a check against the details received from the Service Providers listed on the Service Clearance Contact List.
- 3.2** Where proposed excavations are close to areas that are leased to concessionaires, the Commercial Department must be contacted regarding possible infringements of ground leases, permission to enter tenanted areas, any temporary diversions or other implications from the proposed works.
- 3.3** Using the Service Clearance Contact List (see Appendix B) the OAMC Authorised Person must send a request for service clearance (see Appendix C for a typical request pro-forma) to all the relevant service bodies listed. The request must include a location plan and a plan(s) of sufficiently large scale to identify the area of works to be undertaken. Plans detailing the existing layout of any airfield area can be obtained from the Maintenance Data Office. Should the proposed works be located wholly Landside, then requests for service clearance need only be sent to those services organisations, listed on the Service Clearance Contact List (Appendix B) that have been labelled with the letter 'L' or 'B' (under the column 'Airside/Landside/Both'). Should the proposed works be located wholly Airside, then requests for service clearance need only be sent to those service organisations, listed on the Service Clearance Contact List, that have been labelled with the letter 'A' or 'B'.
- 3.4** With regard to proposed excavations on Landside roads, footpaths or verges, the OAMC Authorised Person needs to ensure that he complies with the normal clearances. On receipt of the 'permission to open' (see Appendix F) the OAMC Authorised Person must still obtain the Permit to dig as described in Section 4 of this Engineering Instruction.
- 3.5** Having completed the 'desk top survey' (see paragraph 3.1) and complied with the requirements of paragraph 3.2 the OAMC Authorised Person must complete the 'Service Clearance Schedule' (Appendix A) with the information received from the relevant service organisations.
- 3.6** In the case of electrical services (whether it is MEW for medium and high voltage or OAMC for low voltage and airfield lighting cables) the Service Provider will attend the site of the proposed works and identify the services present. The OAMC Authorised Person must ensure that adequate time has been allowed for the Service Provider to identify the services.
- 3.7** Where service clearances are required for works adjacent to communications cables the following guidelines should be followed:

- i. The OAMC Authorised Person must inform PACA Communications Section giving details of the works and location.
 - ii. The PACA representative will visit the site, and if possible mark up the services on site.
 - iii. Then in order to obtain written confirmation that service clearance has been requested the formal request for clearance must be in writing to PACA.
- 3.8 It should be noted that completion of the service clearance procedure does not automatically give the Contractor the right to proceed with the works. Other permits, such as those for working Airside, undertaking hot works or working in confined spaces, may also be required.
- 3.9 Having received all the responses from the service organisations the OAMC Authorised Person must sign the Service Clearance Schedule (Appendix A) as a true record of the information received. This document and the Permission to open (where appropriate) enable the OAMC Authorised Person to progress to the next stage, i.e. obtaining the Permit to Dig. (See Part 2).

4. PART 2: PERMIT TO DIG

- 4.1 Having obtained a Services Clearance Certificate the OAMC Authorised Person is responsible for ensuring that no excavations commence without a Permit to dig having first been issued. (Appendix G)
- 4.2 The permit system is intended to provide for safe working and minimise risk exposure.
- 4.3 The following sections provide a framework for safe practice rather than a series of hard and fast rules.

Differing work environs will produce a range of possible scenarios; nevertheless, a consistent approach must be taken. The content of checklists in Appendices D and E are not 100% comprehensive, however, each topic's relevance to specific work projects must be considered.

The OAMC Authorised Person must review each proposed excavation taking account of the checklist items and any other provisions considered necessary.

- 4.4 The possibility that unusual/unexpected ground conditions could arise requires an element of foresight. Where there is any case of doubt, safety concerns must be forwarded to the OAMC Maintenance Manager for assessment/ confirmation/recommendation.

- 4.5** Works adjacent to existing services must be undertaken with particular care. Hand digging is required within a 500mm zone (all directions) of all live services, excepting fuel mains where a 3-meter zone (all directions) is required.

5. PROCEDURE FOR COMPLETING THE PERMIT TO DIG

The OAMC Authorised Person is to complete those sections preceding Part A, i.e. Project Title, Project Reference No etc.

Contact is to be made with the MM / AMM who will issue a Permit Number. The Permit is then passed to the relevant Contractor's Site Manager who is responsible for completing/obtaining all of the information sought in Part A. The form is then passed back to the OAMC Authorised Person. Upon receipt, the OAMC Authorised Person is to sign Part B and distribute copies thus:

Original	-	Contractor
1st copy	-	Airfield Operations (For Airside Works)
2nd copy	-	MM
3rd copy	-	File

When works are completed the Construction Site Manager and the OAMC Authorised Person shall complete Part C, Cancellation. The OAMC Authorised Person should then advise the MM and where appropriate, Airfield Operations of the completion of the works.

6. UNCHARTED SERVICES

The OAMC Authorised Person must ensure that, in the event of locating an uncharted service, the Contractor brings it to the attention of the OAMC supervising representative. The service must then be identified to ensure that it is safe to continue working. The OAMC Supervisor must then contact the Maintenance Data Office (MDO) on Tel: 91425374 to request a survey of the uncharted service. If timescales do not permit a survey by the MDO the OAMC Supervisor should take photographs and the necessary dimensions to fix the location and depth. This information will then be passed on to the MDO/MDM.

7. QUERIES

Any questions relating to this instruction are to be referred to the Maintenance Manager/MDM on 91425374.

CEO

Distribution: - Full

CHIEF EXECUTIVES INSTRUCTION

REPORTING PROCEDURES FOR ACCIDENTS AND DANGEROUS OCCURRENCES	Ref No: CEI / 07 Date: 31/1/2003
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It is the responsibility of all employers to ensure that relevant CEI's are brought to the attention of their staff. However, individuals remain responsible for their own actions and those who are in any doubt should consult their supervisor or manager.

1. INTRODUCTION

- 1.1 To remind all Muscat, Salalah & other Airports (OAMC) staff of the necessary reporting procedure following all incidents and accidents occurring on premises owned or operated by OAMC.

2. REPORTING PROCEDURE FOR ALL INCIDENTS, ACCIDENTS AND DANGEROUS OCCURRENCES

- 2.1 All incidents, accidents, dangerous occurrences involving OAMC staff, employees of other organisations or members of the public should be recorded on Occurrence Reporting & Investigation form within 24 hours. Soft copy Format is available in SMS & also given in this document for reference. For any queries or assistance, HSE dept. can be contacted.
- 2.2 The Accident Report Form (termed as Occurrence Report & investigation form) has been designed to assist staff, to ensure that all relevant information is recorded.
- 2.3 The appropriate copies of the form once completed should be forwarded to the appropriate departments as indicated.
- 2.4 In the case of non OAMC Airport, staff the Manager or Supervisor to whom the

accident/incident has been reported should ensure that the appropriate person is informed in writing so that their organization can complete the necessary reporting formalities.

3. REPORTING PROCEDURES FOR MAJOR INJURIES, DANGEROUS OCCURRENCES AND DISEASES

- 3.1 Certain major injuries and dangerous occurrences are defined as 'reportable'. All reportable major injuries and dangerous occurrences must be reported to the HSE manager.
- 3.2 The definitions of 'reportable major injuries' and 'reportable dangerous occurrences' are outlined in **Appendix A**. HSE Manager can also advise whether or not the incident is 'reportable'.
- 3.3 It is a requirement that all **reportable major injuries and dangerous occurrences** must be notified to the HSE Manager and the Airport Duty Manager immediately by telephone.
- 3.4 The Airport Duty Manager following consultation with the HSE Manager is responsible for ensuring the necessary notifications are made following an incident.
- 3.5 It is also a requirement that any fatal or major injuries or occurrences are reported immediately to the Chief Executive Officer OAMC, who will notify HSE Manager.

4. INVESTIGATION

- 4.1 It is essential that all accidents and incidents, whether or not they are modifiable and no matter how minor, are investigated in order that measures can be taken to prevent similar occurrences which may have similar or more serious consequences. The scale of the investigation will be dictated by the consequences or possible consequences of an incident.
- 4.2 The Manager in control of the work in which the accident occurred responsible for

investigating the accident.

- 4.3 Managers should ensure that every accident is thoroughly investigated to identify the cause and necessary remedial action Line Manager/Supervisor should countersign the forms and ensure that the recommendations are implemented.

5. ENQUIRIES

- 5.1 Any enquiries relating to this instruction should be addressed to the HSE Manager .He can be contacted through telephone no 24341066.

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Chief Executive Officer

Distribution: ALL OAMC depts.

APPENDIX A

Reportable major injuries are:

- i) fracture other than to fingers, thumbs or toes;
- ii) amputation;
- iii) dislocation of the shoulder, hip, knee or spine;
- iv) loss of sight (temporary or permanent);
- v) chemical or hot metal burn to the eye or any penetrating injury to the eye;
- vi) injury resulting from an electric shock or electrical burn leading to unconsciousness or requiring resuscitation or admittance to hospital for more than 24 hours;
- vii) any other injury leading to heatstroke, hypothermia, heat-induced illness or unconsciousness; or requiring resuscitation; or requiring admittance to hospital for more than 24 hours;
- viii) unconsciousness caused by asphyxia or exposure to harmful substances or biological agent;
- ix) acute illness requiring medical treatment, or loss of consciousness arising from absorption of any substance by inhalation, ingestion or through the skin;
- x) acute illness requiring medical treatment where there is reason to believe that this resulted from exposure to a biological agent or its toxins or infected material.

Reportable Dangerous Occurrences are:

- i) any incident involving an aircraft whilst on the ground, whether during maneuvering, refueling, passenger loading / offloading, or any incident involving ground handlers / ground handling equipment.
- ii) any vehicle or equipment incident occurring airside, which is either involved in an incident, or is operated in such a manner as to be considered unsafe.
- iii) Any incident involving passengers, where injuries are sustained, or in circumstances likely to incur injuries.
- iv) collapse, overturning or failure of load-bearing parts of lifts and lifting equipment;
- v) explosion, collapse or bursting of any closed vessel or associated pipe work;
- vi) failure of any freight container in any of its load-bearing parts;
- iv) Plant or equipment coming into contact with overhead power lines;
- v) Electrical short circuit or overload causing fire or explosion;
- vi) any unintentional explosion, misfire, failure of demolition to cause the intended collapse, projection of material beyond a site boundary, injury caused by an explosion;

- vii) accidental release of a biological agent likely to cause severe human illness;
- viii) failure of industrial radiography or irradiation equipment to de-energise or return to its safe position after the intended exposure period;
- ix) malfunction of breathing apparatus while in use or during testing immediately before use;
- x) collapse or partial collapse of a scaffold over five metres high, or erected near water where there could be a risk of drowning after a fall;
- xi) dangerous occurrence at a pipeline;
- xii) a road tanker carrying a dangerous substance overturns, suffers serious damage, catches fire or the substance is released;
- xiii) a dangerous substance being conveyed by road is involved in a fire or released;
- xviii) unintended collapse of any building or structure under construction, alteration or demolition where over five tonnes of material falls; a wall or floor in a place of work; and false work;
- xix) explosion or fire causing suspension of normal work over 24 hours;
- xx) sudden, uncontrolled release in a building: 100kg or more of flammable liquid; 10kg of flammable liquid above its boiling point; 10kg or more of flammable gas; or of 500kg of these substances if the release is in the open air;
- xxi) Accidental release of any substance which may damage health.

Reportable diseases include:

- i) certain poisonings;
- ii) some skin diseases such as occupational dermatitis, skin cancer, chrome ulcer, oil folliculitis/acne;
- iii) lung diseases including: occupational asthma, farmer's lung, pneumoconiosis, asbestosis, mesothelioma;
- iv) infections such as: leptospirosis, tuberculosis, anthrax, legionellosis and tetanus;
- v) other conditions such as: occupational cancer; certain musculoskeletal disorders; decompression illness and hand-arm vibration syndrome.

APPENDICES

Appendix **A** Services Clearance Schedule

Appendix **B** Service Clearance Contact List

Appendix **C** Typical Services Clearance Pro-forma

Appendix **D** Safety Checklist of items for consideration prior to works commencement

Appendix **E** Safety Checklist of items for consideration whilst works are progressing

Appendix **F** Permission to Open Roads

Appendix **G** Permit to Dig, Pile and Drive

Appendix **H** Hot work Permit

Appendix **I** Airside Work Permit

Appendix **J** Project Control Management of Risk

Appendix **K** Hazard report & investigation

Appendix **L** Occurrence Report & Investigation

SERVICE CLEARANCE SCHEDULE

WORKS ORDER NUMBER _____ PROJECT _____ EXCAVATION LOCATION _____ PLAN REF _____

Planning (to be completed by the Authorised Representative (Project Manager)) The following clearances are to be obtained prior to any digging.	(1) Have responses been provided by these groups*	(2) Are there services in the vicinity of proposed excavation	(3) Are services appropriately marked out on surface	(4) Services Clearance Remarks	(5) Trial Hole required	
SERVICES	Date	Date provided	YES / NO	YES	NO	YES/NO
MEW HV/MV						
ELECTRICITY LV & OTHER CABLING						
AIRFIELD LIGHTING - OAMC						
WATER - OAMC						
- WATER AUTHORITY						
SURFACE DRAINAGE						
SEWERAGE FOUL						
FIRE MAINS						
TELECOMMUNICATIONS PACA						
" OAMC						
" OA						
SERVICE DUCTS OR TUNNELS						
FIBRE OPTICS (please specify) PACA						
OAMC						
OA						
SECURITY SYSTEMS						

All replies to be attached

Signed as a true record of information received

SERVICE CLEARANCE CONTACT LIST
(MUSCAT INTERNATIONAL AIRPORT)

SERVICES	AIRSIDE/ LANDSIDE/BOTH	CONTACT NAME	TELEPHONE NUMBER	E-mail ID
MUSCAT POWER WHV & MV	B	Majid Al Hasani./RS Sundaram	24341204/95339215	
ELECTRICITY LV& OTHER CABLING	B	Majid Al Hasani./RS Sundaram	24341204/95339215	
AIRFIELD LIGHTING	B	Abdulaziz Al Hinai.	97222020	
WATER AUTHORITY	L	Ibrahim Al-Rawahi.	24341315/91371515	
OAMC WATER	B	Ibrahim Al-Rawahi.	24341315/91371515	
SURFACE DRAINAGE Airside Landside	A	Wail Al Saleh	98561762	
	L	Wail Al Saleh	98561762	
SEWERAGE (FOUL)	B	Ibrahim Al-Rawahi./ Rase	24341315/91371515	
FIRE MAINS	B	Ibrahim Al-Rawahi.	24341315/91371515	
TELECOMMS (BT) PPO Control	B	Shirjan Al-Bulushi.	24341398	
TELECOMMUNICATIONS (EUROBELL)	B	Shirjan AlBalushi.	24341398	
SERVICE DUCTS LANDSIDE " AIRSIDE	L	MDM	91425374	
	A	MDM	91425374	
FIBRE OPTICS PACA OAMC OA	B	Salim AlFarsi	99333920	
	B	MDM	91425374	
	B	MDM	91425374	
SECURITY SYSTEM	A	MDM/ICT	91425374/24341111	
ROADS	L	Wail Al Saleh	98561762	

Apart from this **MDM** can be contacted for proper guidance. Telephone **91425374**

OMAN AIRPORTS MANAGEMENT COMPANY SERVICES CLEARANCE

MAINTENANCE DEPARTMENT

Reference No

Date

To: Oman Airports Management Company
Muscat International Airport

Organisation: P.O. Box 1707, Post Code 111, C.P.O.
Muscat

Tel No:

Tel No: 24341000

Fax No:

Fax No: 24518088

We propose to commence excavations at the locations stated below on and request you to indicate us whether there are any of your services laid within the areas specified on the attached site plan.

LOCATION OF EXCAVATION:

BRIEF DETAILS OF WORK TO BE CARRIED OUT:

DATE WORK IS TO COMMENCE ON SITE:

SIGNED FOR OMAN AIRPORTS MANAGEMENT COMPANY

IN CAPACITY OF

Date:

APPENDIX D

SAFETY CHECK LIST

PRIOR TO COMMENCING WORK

1. The positions of all on site services should be determined by OAMC Authorised Representative and adequately marked and/or disconnected. []
2. For the purpose of excavation, no ground should be considered 'good' or 'safe' until it has been investigated. In the case of piling for example a geotechnical report will be required with soil analysis/interpretation by a qualified Engineer. []
3. Earthwork support should be designed by or in consultation with a competent Engineer. []
4. Earthwork support and methodology of excavation should be designed so as not to affect adjacent roads, paving and structures.
(Note particularly surcharging) []
5. Prevent unauthorized access - especially the general public and passengers. []
6. Always seek the advice of OAMC Authorised Representative before excavating below existing foundations. It may be necessary to provide shoring. []
7. Provide an adequate supply of material for support work, barriers and correct traffic notices. []
8. Make provisions for poling boards to stand proud of existing ground levels. This prevents loose material falling into the excavations. []
9. Check for provision of adequate task and background feature lighting. []
10. Provide adequate and suitable access ladders and securing straps. []

11. Determine positions of bridges, temporary roads and spoil heaps (where applicable). []
12. Determine methods of excavating, installing and removing support work. []
13. Ensure access/egress from the excavation has been determined / confirmed. []
14. Ensure equipment to be used will not hinder/foul overhead features, live cabling etc. []
15. If excavation is by equipment likely to generate substantial noise, forewarn all adjacent tenants. Arrange for noise monitoring if in doubt. []
16. Where deep excavations or piling is envisaged ensure that there are no lower level obstructions e.g. underground 'tube' lines, culverts, deep sewers etc. []
17. For piling, ensure that if local aquifers are likely to be penetrated, that the responsible water authority has agreed to the proposed Method Statement. []
18. Will the excavation require the use of materials, which are to be covered by COSHH If so has an assessment been carried out and do all the employees involved know the outcome. []
19. Ensure adequate risk assessments have been carried out for the works and the tasks to be performed. Where work is likely to involve contact with existing buried services, a safe system of work must be developed to the satisfaction of the 'service owner' and the OAMC Authorised Representative. []
20. Excavation works are to be supervised by experienced, competent persons with adequate knowledge of hazards associated with this type of work. []

SAFETY CHECK LIST**WHILST WORK IS IN PROGRESS**

1. Ensure sound material is being used. []
2. Ensure that approved and safe methods/safe systems of work are adopted for the installation of support work in excavations. An Authorised Representative should be in attendance at all times. []
3. Ensure that all working surfaces are safe. Is dewatering required? []
4. Install earthwork support as soon as practically possible. This should be done from a work cage, from ground level or from inside existing timbering. (In some ground conditions earthwork support needs to be installed and braced as the excavation proceeds.) []
5. Ensure that all support work is secure and that props and wedges are tight and properly maintained. []
6. Check for signs of over-stress in support work, damage from plant and, when timber is used, make long term check for disease/defects, i.e. dry rot, shakes etc. []
7. Check for water or soil seeping through support work. Where dewatering is required, review contingency plans and method of disposing of water. []
8. Check for signs of earth peeling/cracking at supported as well as unsupported faces. []
9. Check that there are suitable ladders, that they are properly maintained and secured. []

10. When dewatering, ensure that there are adequate sumps and that materials are not being drawn from behind support work. []
11. Ensure safe systems of work for Confined Spaces. []
12. Ensure that spoil heaps and other materials are kept back from the edges of the excavation. Keep stockpiling 3 metres from Airside fences. []
13. Ensure that there are adequate barriers/notices/warning lights. []
14. The edges of excavations should be provided with guardrails. []
15. Ensure that 'stops' for mobile plant and vehicles are correctly positioned and well anchored. []
16. Ensure that all passing traffic is kept a suitable distance back from the edge of excavations.
(This will vary dependant on local conditions and the earthwork support system employed.) []
17. Ensure correct method of withdrawing support work is used; if unsafe to strike - leave in. []
18. Ensure that persons are not working too close to machines or each other. []
19. Ensure that personal protective clothing/equipment is available at all times and being used
by all personnel. []
20. Ensure that persons are wearing suitable ear defenders where noise levels dictate. []

21. Ensure that machine operators have the best possible vision of work in progress and/or are using banks men. []
22. Ensure that services are marked and protected and adequately supported when exposed in excavations. []
23. Ensure that backfilling is being carried out correctly in compacted layers not exceeding 150mm, in planned sequence, and maintained after settlement. []
24. Carry out inspections daily, prior to each shift, or after inclement weather, particularly frost and rain. []
25. Ensure that a record of all examinations is properly recorded and signed by the Authorised Representative. []

CONSENT TO OPENING

Date

From

To

ROADS

Ref No: Section: Notice No: Plan No:

Of OAMC Opening Consent No:

FORMAL APPROVAL is given to your works subject to the route specified. The comments on the attached sheets should be taken into consideration, as agreed with your representative and our Assistants.

Your works may commence

Subject to _____ and taking the following points into consideration.

Other comments:

.....

.....

.....

Any enquiries regarding this Notice should be made to the Maintenance Manager, on Tel: 24341315.

91425374 MDM on telephone

OAMC PERMIT TO DIG, FORM

Project Title Project Reference No ...
 Excavation Location Excavation Dimensions l, b, d
 Plan Reference/Grid Reference
 PERMIT NO:(given by MM'

PART – A

To be completed by relevant OAMC Contractor's Site Manager

I, (name)
 of (Company/Contractor)formally request a Permit to Excavate the
 area indicated above (include part plan to illustrate where this is helpful) for the purpose
 of:

.....
 Signed Position Dated ...Copy
 to: MM

PART – B

	Included	To Follow	Not Applicable	Notes
Method Statement(s)/Risk Assessment				
Services Clearance				
Schedule of Plant involved				
Schedule of Equipment Involved excluding PPE				
Schedule of PPE				
Description of Power Service anticipated (e.gfor task lighting)				
Schedule of LPG, HFL or other hazardous chemicals anticipated during excavation				
Schedule of materials to be used during excavation				

Schedule of Fire Fighting apparatus involved during excavation				
Depth of ground water level				
Details of Contingency Plans				

To be completed by relevant Site Manager/Project Manager who has awarded this job
to Contractor

(Note - This part is applicable only when job is not under OAMC)

I, (name) of (Company/Contractor) have studied the method statement & risk assessment & formally request a Permit from OAMC to Excavate the area indicated above:

Signed

Position

... Dated

Information included with request

PART – C

To be completed by the OAMC Project Owner /Authorised Person as per the reference of OAMC ISMS.

I, being the OAMC Authorised Person for the above Project confirm that I have studied the submitted approved Method Statement(s) and Risk Assessment supplementary information and am satisfied that the contractor has demonstrated a good understanding of the Works involved and shall be issued with this Permit to Dig

NB:OAMC will undertake regular checks to ensure that Contractors are complying with submitted Method Statements.

Signed Position Dated

Copies to: Original - CONTRACTOR: OPS: MM: FILE

THIS PERMIT IS VALID FROM HOURS ON UNTIL
.....

HOURS ON

PART D - CANCELLATION

To be completed by OAMC's Contractor's Site Manager and OAMC's Authorised Person. I have completed the work in this Permit and restored to works area to a safe condition. I have returned my copy of this Permit to the OAMC Authorised Person.

Signed (Contractor's Site Manager) Date

I accept that the work has been safely completed

Signed (OAMC Authorised Person) / Date
.....

HOT WORK PERMIT

Hot work would mainly comprise - Welding, Gas-cutting, use of Open Flames or other sources of fire in a fire-prone place containing inflammable substances, explosives & / or other such highly combustible materials susceptible to spontaneous ignition & / or explosion.)

Sl. No	Details	Remarks		
		Yes	No	Not Required
1.	Has the area immediately below the work spot, been cleared / removed of oil, grease & waste cotton etc.?			
2.	Has Gas concentration been tested in case there is gas valve/gas line nearby?			
3.	Have fire extinguishers been kept handy at site?			
4.	Has tin sheet/ wet gunny bag/ fire retardant cloth / sheet been placed to prevent sparks from causing fire?			
5.	Has water hose connection been made for continuous water spray?			
6.	Have all the drain inlets (if any) been closed?			
7.	Any other precautions taken (specify): _____			

The person-taking permit (permitted) to fill up:

Exact location where hot work is being planned. _____

Approximate duration of work. From: Date: _____ / Time _____

To: Date _____ / Time _____

Points to be checked

The above points have been complied with and conditions rendered safe / hazards innocuous to undertake the hot work.

Name of _____ Signature _____ Designation _____

Permittee (Site engineer/Project Engineer)

Date: _____ Time _____

B) The person-giving permit (issuing authority) to fill up:

After checking all the above precautions the hot work can be carried out in the above area.

Name & Signature: of _____

Issuing authority (OAMC)	Maintenance Manager (OAMC)	Chief Fire Officer
-----------------------------	----------------------------	--------------------

C) Time _____ Date _____ at which the permit closed & filed.

Name of Maintenance Manager

Chief Fire Officer

Distribution:-

CC: - Fire Department (OAMC)

CC: - Maintenance Department (OAMC)

CC: - HSE Department

AIRSIDE WORK PERMIT / WORK AUTHORIZATION

Permit Sl. No-----

Work clearance from ----- hrs of date ----- To----- hrs of date-----

Issued to (Department /Section / Contractor) -----

Description of Work -----

The Following items shall be checked before issuing the work authorization or permit in airside. (Tick mark in the appropriate box)

Sl. No	Item	Yes	Not Required	Remarks
1	Method of work plan & Risk Assessment Submitted			
2	AVP & ADP issued in case of vehicle usage			
3	NOTAM issued			
4	Considered hazard from other operations and concerned persons alerted.			
5	Hot / Dig Permit issued			
6	Staff/person aware about Ramp Safety Rules & Regulation			

Issuer Name & designation	Issuer Signature	Receiver Name & Designation	Receiver Signature

Closing of the Work Permit or Work Authorization

Receiver: Certified that the subject work has been completed /stopped and area cleaned.			Issuer: Verified that the job has been completed & area cleaned and is safe from any hazard.		
Date & Time	Name & Designation	Signature	Date & Time	Name & Designation	Signature

CC: - HSE Department Muscat

Note:- Permit Issuer will be ADM/ Compliance & certification Manager /AFDM

OMAN AIRPORTS MANAGEMENT COMPANY S.A.O.C

PROJECT CONTROL MANAGEMENT OF RISK

General

As part of our process of managing risk, all projects – either carried out in house or by external contractors is risk assessed. No Project is Exempt.

Once we have identified the hazards and risks associated with a project, we can then identify what defences and barriers we can put in place to mitigate the risk.

To ensure that defences and barriers identified in risk assessment as control measures are implemented and that risks are managed, we need to implement a system where:

- a) Control measures previously identified are practically managed.
- b) Individual responsibilities are defined.

To achieve these objectives, the attached sheet (Project Control-Administration) must be prepared for all projects. Those people identified as being responsible, must sign as a declaration that they take responsibility for the practical application of the control measures.

This is another layer of administration; it is a significant working document, which is an essential part of our ISMS system.

Please ensure that all OAMC's staff and contractors are fully conversant with our safety procedures and that control measures are always followed.

Thank you for your cooperation.

CEO

PROJECT CONTROL – MANAGEMENT OF RISK**PROJECT:****AIRPORT:**

AIRSIDE / LANDSIDE

SPECIFIC LOCATION:**BRIEF DESCRIPTION:****CONTRACTOR:****OAMC DEPARTMENT:****PROJECT START DATE:****DURATION:****RISK ASSESSMENT No:****OAMC RESPONSIBLE OFFICER:**

Signature:

Date:

Ref.	CONTROL MEASURES	RESPONSIBLE PERSON
1.		
2.		
3.		

I have been briefed on all aspects of the Project. I have a copy of the risk assessment and I have read and understood the Control Measures and actions required to reduce risks.

I will be responsible to ensure that the control measures are in place, and all actions necessary to manage the risk are implemented.

Name:Signature: Date:Designation:

Name:Signature: Date:Designation:

Original: HSE Manager – Master File

Copies: Responsible Officer /Responsible Persons/ Insurance Advisor



HAZARD REPORT & INVESTIGATION



WHAT IS HAZARD? Hazard is anything has potential to cause harm

NOTE: Significant Hazard must be reported **IMMEDIATELY** to ADM by call

PART – 1 HAZARD REPORT "To be submitted to ADM/ HSE Department"

A- Hazard Details Confidential NO (Normal Report)

Type of Hazard Unsafe Act If other
Hazard Location Airside Exact area

B- Hazard Description

Observation – (include area, task, condition, equipment, tools, object and people involved)

Potential Cause(s) – (lack of training/ supervision/ SOP/ resources, human factor, weather condition, etc.)

Potential Effects /Consequences – (e.g. injury, damage to property/ environment, etc.)

Immediate Action Taken – (e.g. person advised, concern supervisor informed, etc.)

Recommendation – (possible solution for fixing the problem or prevent a repeat)

Reported By. Reporting End Here Date Time
Name Title Staff No. Organization Department Contact

PART – 2 HAZARD INVESTIGATION & ACTION (Concern & Action Party)

A- Hazard Analysis

B- Recommendations Action Party Date Of Completion Closeout Status By Action Party
Status Remarks/ Feedback

..... Open
.....
.....
.....

Investigation By. Date Time
Name Title Staff No. Organization Department Contact

.....
.....
.....

NOTE: All Occurrences must be reported **IMMEDIATELY** to ADM by call

PART – 1 OCCURRENCE REPORT "To be submitted within 24 hour to ADM & HSE Department"

A- Occurrence Details

Type of Occurrence	Environmental Damage	Other		Severity	NIL
Location	Other	Exact Area			
Organization(s) Involved		Department(s)		Date
				Time	

B- Occurrence Description:

--

C- Occurrence Pictures: (Real Pictures or Simulating)

D- Personal Involve Details (NIL)

No	Name	Title	Staff No.	Organization	Department	Contact	Role Involve
							...

E- Injury & Treatment Details (NIL)

Injured No.	Injury Description (e.g. fracture, bruise, cut)	Treatment Details (e.g. first-aid, hospital address & sick leave)	Final Destination

						...
F- Damage Details (NIL)						
Damage to	Organization	Type	Number	Damage Description		
....						
Reported By. Reporting End Here			Date	Time	
Name	Title	Staff No.	Organization	Department	Contact	

PART 2- OCCURRENCE INVESTIGATION "To be submitted within 1 week to -HSE Department otherwise to be justified"						
A- Occurrence Data Collection:						
1- Interview Details						
2- Site Visit Finding						
3- Documents Review Outcome						
B- Occurrence Analysis						
1- Direct Causes	Recommendations	Action Party	Date Of Completion	Closeout Status By Action Party		
				Status	Remarks/ Feedback	
				Open		
2- Indirect Causes	Recommendations	Action Party	Date Of Completion	Closeout Status By Action Party		
				Status	Remarks/ Feedback	
				Closed		
3- Root Causes	Recommendations	Action Party	Date Of Completion	Closeout Status By Action Party		
				Status	Remarks/ Feedback	
				Closed		
C- Occurrence Impact details						
D- Learning Points						

Investigation Done By			Date	Time
Name	Title	Staff No.	Organization	Department	Contact
E- Appendix					

(Annex 4)

Mandatory List (Products & Services)



Office Supplies

Code	Segment Title	Commodity Title	Commodity Definition	Commodity Description	Made in Oman	Local Suppliers
RF11	Office Supplies	RF11.1 Stationary	This is defined as any product that is used in an office.	RF11.1.1. Stickers	No	Yes
				RF11.1.2. Ink	No	Yes
				RF11.1.3. Notebook	No	Yes
				RF11.1.4. Pens & Pencils	No	Yes
				RF11.1.5. Envelopes	No	Yes
				RF11.1.6. Markers	No	Yes
				RF11.1.7. Highlighters	No	Yes
				RF11.1.8. Clips	No	Yes
				RF11.1.9. Staplers	No	Yes
				RF11.1.10. Tape	No	Yes
				RF11.1.11. Pins	No	Yes
				RF11.1.12. Files/Folders	No	Yes

Office Supplies & Uniform

Code	Segment Title	Commodity Title	Commodity Definition	Commodity Description	Made in Oman	Local Suppliers
RF11	Office Supplies	RF11.2. Other Office Supplies	This is defined as any product that is used in an office.	RF11.2.1. Tissue Box	Yes	Yes
RF12	Uniform	RF12.1. Uniform	It is defined as a dress of a distinctive design or fashion worn by members of a particular group and serving as a means of identification broadly.	RF12.1.1. Service Uniform	Yes	Yes
				RF12.1.2. Working Uniform	Yes	Yes

Cleaning Products & Chemicals

Code	Segment Title	Commodity Title	Commodity Definition	Commodity Description	Made in Oman	Local Suppliers
RF13	Cleaning Products	RF13.1 Soaps	A substance used with water for cleaning and washing.	RF13.1.1. Hand wash liquid soap	Yes	Yes
				RF13.1.2. Toiletry Soap	Yes	Yes
RF14	Cleaning Chemicals	RF14.2 Sanitization	A substance used for cleaning something to make it free of bacteria.	RF14.2.2. Hand Sanitizer	Yes	Yes

Gifts

Code	Segment Title	Commodity Title	Commodity Definition	Commodity Description	Made in Oman	Local Suppliers
RF18	Gifts	RF18.1. Crafting Products	Products that are produced by artisans, either completely by hand.	18.1.1. All kinds of crafting products	Yes	Yes
		RF18.2. Paintings	A picture created by putting paint on a surface.	18.2.1. Handmade Painting	Yes	Yes
				18.2.2. Manufactured Paintings	No	Yes
		RF18.3. Staff Presents & Giveaways	Gifts and small presents for workers or customers.	RF18.3.1. Personalised Notebooks	Yes	Yes
				RF18.3.2. Personalised Bookmarks	Yes	Yes
				RF18.3.3. Chocolates	Yes	Yes
				RF18.3.4. Gift Cards	No	Yes

Media

Code	Segment Title	Commodity Title	Commodity Definition	Commodity Description	Made in Oman	Local Suppliers
RF22	Media	RF22.1. Photography & Videography	Photos and videos taken in an event.	RF22.1.1. Event Photography	No	Yes
				RF22.1.2. Training Photography	No	Yes
				RF22.1.3. Social Media Photography	No	Yes
				RF22.1.4. Advetsinment Photography	No	Yes
				RF22.1.5. Event Videography	No	Yes
				RF22.1.6. Training Videography	No	Yes
				RF22.1.7. Social Media Videography	No	Yes
				RF22.1.8. Advertisement Videography	No	Yes

Media

Code	Segment Title	Commodity Title	Commodity Definition	Commodity Description	Made in Oman	Local Suppliers
RF22	Media	RF22.2. Branding	The promotion of a particular product or company by means of advertising and distinctive design.	RF22.2.1. Brand Logo	No	Yes
				RF22.2.2. Imagery	No	Yes
				RF22.2.3. Identity	No	Yes
				RF22.2.4. Tagline	No	Yes
		RF22.3. Event Management	Managing the development, creation of small/large events such as ceremonies, conferences, etc.	RF22.3.1. Event Concept	No	Yes
				RF22.3.2. Event Coordination	No	Yes
				RF22.3.3. Event Venue	No	Yes
				RF22.3.4. Event Organizers	No	Yes
				RF22.3.5. Advertisement Agency	No	Yes

Media

Code	Segment Title	Commodity Title	Commodity Definition	Commodity Description	Made in Oman	Local Suppliers
RF22	Media	RF22.4. Marketing	Business of promoting products and selling services including market research and advertisement.	RF22.4.1. Social Media Marketing	No	Yes
				RF22.4.2. Promotions	No	Yes
				RF22.4.3. Banners and Brochures	No	Yes
				RF22.4.4. Marketing Plan	No	Yes

Legal

Code	Segment Title	Commodity Title	Commodity Definition	Commodity Description	Made in Oman	Local Suppliers
RF27	Legal	27.1. Legal Services	Any service that may only be provided by a person licensed, admitted, or otherwise qualified to practice law in the jurisdiction in which the service is provided.	RF27.1.4. Manpower legal consultation	No	Yes
				RF27.2.1. All Kinds of translation, including Media and Legal	No	Yes

Waste Management

Code	Segment Title	Commodity Title	Commodity Definition	Commodity Description	Made in Oman	Local Suppliers
RF30	Waste Management	RF30.1. Waste Management Services	This is known for collection, transport, and treatment of disposal waste.	RF30.1.1. Outsourcing Labors for Waste Segregation and Cleaning	No	Yes

General Consumables

Code	Segment Title	Commodity Title	Commodity Definition	Commodity Description	Made in Oman	Local Suppliers
RF35	General Consumable Products	RF35.1. Disposals	This is known as items on which food is served, made from cardboard.	RF35.1.1. Paper Cups	Yes	Yes
				RF35.1.2. Disposable Plates	Yes	Yes
				RF35.1.3. Disposable Bowls	Yes	Yes
				RF35.1.4. Disposable Cutlery	Yes	Yes
				RF35.1.5. Napkins	Yes	Yes

Non Destructive Testing

Code	Segment Title	Commodity Title	Commodity Definition	Commodity Description	Made in Oman	Local Suppliers
RF36	Non Destructive Testing (NDT)	RF36.1. Non Destructive Testing	Nondestructive testing (NDT) is the process of inspecting, testing, or evaluating materials, components or assemblies for discontinuities, or differences in characteristics without destroying the serviceability of the part or system.	RF36.1.1. All Types of NDT	No	Yes

Cables

Code	Segment Title	Commodity Title	Commodity Definition	Commodity Description	Made in Oman	Local Suppliers
RF37	Cables	RF37.1. Cables	A conductor or group of conductors for transmitting electric power or telecommunication signals from one place to another.	37.1.1. Industrial Cables	Yes	Yes
				37.1.2. Commercial Cables	Yes	Yes
				37.1.3. Optical Fiber Cables	Yes	Yes

Wooden Pallets

Code	Segment Title	Commodity Title	Commodity Definition	Commodity Description	Made in Oman	Local Suppliers
RF38	Wooden Pallets	RF38.1. Wooden Pallets	A flat wooden structure that heavy goods are put onto so that they can be moved using a fork-lift truck	38.1.1. Heavy Duty Wooden Pallet	No	Yes
				38.1.2. Euro Wooden Pallet	No	Yes
				38.1.3. 2 Way Wooden Pallet	No	Yes
				38.1.4. 4 Way Wood Stringer Pallet	No	Yes
				38.1.5. Coil Field Wooden Pallet	No	Yes
				38.1.6. Chemical Pallets	No	Yes

Wooden Pallets

Code	Segment Title	Commodity Title	Commodity Definition	Commodity Description	Made in Oman	Local Suppliers
RF38	Wooden Pallets	RF38.1. Wooden Pallets	A flat wooden structure that heavy goods are put onto so that they can be moved using a fork-lift truck	38.1.7. Hybrid Pallet	No	Yes
				38.1.8. Fumigated Pallet	No	Yes
				38.1.9. Block Pallet	No	Yes
				38.1.10. Perimeter Pallet	No	Yes

Dairy Products

Code	Segment Title	Commodity Title	Commodity Definition	Commodity Description	Made in Oman	Local Suppliers
RF4	Dairy products and eggs	RF4.2 Fresh Milk & butter products	This item is defined as products made from fresh milk or butter.	RF4.2.1. Salted Butter	Yes	Yes
				RF4.2.2. Unsalted Butter	Yes	Yes
				RF4.2.3. Yogurt - All Flavours	Yes	Yes
				RF4.2.4. Laban	Yes	Yes
				RF4.2.5. Fresh milk	Yes	Yes
				RF4.2.6. Fresh flavoured milk	Yes	Yes
				RF4.2.7. Cream	Yes	Yes

Dairy Products & Eggs

Code	Segment Title	Commodity Title	Commodity Definition	Commodity Description	Made in Oman	Local Suppliers
RF4	Dairy products and eggs	RF4.3 Dairy Products	This includes all dairy products. This includes all dairy products.	RF4.3.1. Fresh Eggs	Yes	Yes
				RF4.3.2. Frozen Eggs	Yes	Yes
				RF4.3.3. Labneh	Yes	Yes
				RF4.3.4. Cheese slices	Yes	Yes
				RF4.3.5. Cream cheese	Yes	Yes
				RF4.3.6. Cheddar cheese	Yes	Yes

Bread & Bakery Products

Code	Segment Title	Commodity Title	Commodity Definition	Commodity Description	Made in Oman	Local Suppliers
RF5	Bread and Bakery Products	RF5.1. Bread	This item is defined as a flour-based food product.	RF5.1.9. Flat bread	Yes	Yes
				RF5.1.10. Buns	Yes	Yes

Oil , Confectionary Products , Beverages

Code	Segment Title	Commodity Title	Commodity Definition	Commodity Description	Made in Oman	Local Suppliers
RF6	Oil	RF6.1 Edible vegetable and plant oils	This item is identified as oils derived from plant sources.	RF6.1.1. Vegetable oil	Yes	Yes
RF7	Confectionary Products	RF7.2. Honey	This item is known as sweet food substance.	RF7.2.1. Natural Honey	Yes	Yes
				RF7.2.2. Flavored Honey	Yes	Yes
		RF7.3. Dates	It is defined as a flowering plant species in the palm family, Aceraceae, cultivated for its edible sweet fruit.	RF7.3.1. Plain Dates	Yes	Yes
				RF7.3.2. Stuffed Dates	Yes	Yes
RF10	Beverages	RF10.1 Beverages	Beverages/Water	RF10.1. Water	Yes	Yes

Buses

Code	Segment Title	Commodity Title	Commodity Definition	Commodity Description	Made in Oman	Local Suppliers
RF55	Motor Manufacturing	RF55.1. Buses	This includes manufacturing and producing motors.	RF55.1.1. City Buses	Yes	Yes
				RF55.1.2. School Buses	Yes	Yes
				RF55.1.3. Coach Buses	Yes	Yes

Medicine

Code	Segment Title	Commodity Title	Commodity Definition	Commodity Description	Made in Oman	Local Suppliers
RF58	Medicine	RF58.1. Pharmaceutical Drugs	This includes medicine.	RF58.1.1. LPID Lowering Drugs	Yes	Yes
				RF58.1.2. Carido Vasculars Drugs	Yes	Yes
				RF58.1.3. Anti Allergic Drugs	Yes	Yes
				RF58.1.4. Anti Bacterials Drugs	Yes	Yes
				RF58.1.5. Niche & Mass Drugs	Yes	Yes
				RF58.1.6. Non Steroidal Anti Inflammatory Drugs	Yes	Yes

Medicine

Code	Segment Title	Commodity Title	Commodity Definition	Commodity Description	Made in Oman	Local Suppliers
RF58	Medicine	RF58.1. Pharmaceutical Drugs	This includes medicine.	RF58.1.7. Gastro Insetinal Drugs	Yes	Yes
				RF58.1.8. Anti Diabetic Drugs	Yes	Yes
				RF58.1.9. Anti Depressant Drugs	Yes	Yes
				RF58.1.10. Analgesic Antipyretic Drugs	Yes	Yes
				RF58.1.11. Central Nervous System Drugs	Yes	Yes



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الرقم: م ع ت ط م / ٣ / ٣ / ٤

التاريخ: ١٤ رمضان ١٤٤٤ هـ

الموافق: ٣ أبريل ٢٠٢٣ م

المحترم

المهندس / عادل بن عبدالله اليافعي
نائب الرئيس لوحدة الخدمات الفنية
مطارات عمان

السلام عليكم ورحمة الله وبركاته، وبعد،،،

الموضوع: طلب الموافقة على تركيب الألواح الشمسية في مطار مسقط الدولي.

بالإشارة إلى خطابكم رقم OA/COR/TES/349/2023 بتاريخ ١ مارس ٢٠٢٣ م ، بخصوص الموضوع المذكور أعلاه .

نود إفادتكم بالموافقة على تركيب الألواح الشمسية المولدة للطاقة الكهربائية لمطار مسقط الدولي حسب الاحداثيات والمواصفات الفنية المرفقة مع خطابكم المذكور أعلاه ، كما يرجى مراعاة ما يلي:

١- في حالة رغبة مقاول المشروع باستخدام رافعة بموقع المشروع يرجى التقدم بطلب تصريح للرافعة.

٢- في حالة تبين أن هذه الألواح تشكل خطراً على سلامة الحركة الجوية و نظم الملاحة الجوية الخاصة بمطار مسقط الدولي فإن الهيئة سوف تلزمكم بإزالتها.



الم
عام تنظيم الطيران
CAAT
SULTANATE OF OMAN
DIRECTORATE GENERAL OF CIVIL AVIATION REGULATION
المديرية العامة لتنظيم الطيران المدني



الرقم: م ع ت ط م / ٣ / ٣ / ٤ / ٣ / ٢٠٢٣ / ٢٠٢٣
التاريخ: ٨ ذو القعدة ١٤٤٤ هـ
الموافق: ٢٨ مايو ٢٠٢٣ م

المهندس / عادل بن عبدالله اليافعي
نائب الرئيس لوحدة الخدمات الفنية
مطارات عمان
المحترم

السلام عليكم ورحمة الله وبركاته، وبعد،،،

الموضوع: طلب الموافقة على تركيب الألواح الشمسية في مطار صلالة.

بالإشارة إلى خطابكم رقم OA/COR/TES/456/2023 بتاريخ ١٥ مارس ٢٠٢٣ م ، بخصوص الموضوع المذكور أعلاه .

نود إفادتكم بالموافقة على تركيب الألواح الشمسية المولدة للطاقة الكهربائية لمطار صلالة حسب الاحداثيات والمواصفات الفنية المرفقة مع خطابكم المذكور أعلاه ، كما يرجى مراعاة ما يلي:

١- في حالة رغبة مقاول المشروع باستخدام رافعة بموقع المشروع يرجى التقدم بطلب تصريح للرافعة.

٢- في حالة تبين أن هذه الألواح تشكل خطراً على سلامة الحركة الجوية و نظم الملاحة الجوية الخاصة بمطار صلالة فإن الهيئة سوف تلزمكم بإزالتها.



٣- أن تكون جميع ألواح الطاقة الشمسية التي سيتم تركيبها في المواقع المحددة بخطابكم تحتوي على طلاء مضاد لضوء الشمس (Anti glaring) لتفادي حدوث الأنعكاس من الألواح وذلك من أجل سلامة حركة الطيران.

٤- التأكد من أن المعدات التي سيتم تركيبها لا تتسبب في جذب الأحياء البرية والتي قد تؤثر على سلامة حركة الطيران.

٥- تجاوز الارتفاع والإستخدام المسموح به والمساحة المحددة في المخطط الهندسي يخضع للمسائلة القانونية وفق قانون الطيران المدني، الصادر بالمرسوم السلطاني رقم ٢٠١٩/٧٦.

٦- هيئة الطيران المدني لن تتحمل أية مسؤولية حول ما قد يترتب على ذلك من أضرار نتيجة لحركة الطيران.

٧- تعتبر هذه الموافقة سارية المفعول لمدة سنة من تاريخ إصدارها.

وتفضلوا بقبول فائق الاحترام ،،،،،؛

سالم بن حمد بن سعيد الحسيني
مدير عام تنظيم الطيران المدني بالندب



Tentative Bill of Quantities		Location		Muscat	Salalah
		DC Capacity in Wp			
Packages	Material	Material Technical Description	Unit	Quantity	Quantity
Modules	PV Modules	580Wp Monofacial Module (Jinko)	Nos.		
	String inverter				
Inverter	String Inverter	295kW,800V String Inverter - Sungrow	Nos.		
Inverter	Corn 100 Units	PLC communication unit for string inverters	Nos.		
	Module Mounting Structure (2P X 26)				
MMS	MMS	HDG Material-	MT		
MMS	MMS	SS304 Fastener	MT		
MMS	Pile foundation	Pile foundations (RCC, M25), Approx 2 mtrs below ground, 300mm dia with 150mm pile cap	Nos.		
MMS I&C	MMS Assembly	Structure erection or MMS assembly as per drawing	MWp		
MMS I&C	Module installation	As per GA drawing & Instruction Manual of OEM	Nos.		
	Cleaning System				
MCS	Semi Automatic Robots (Pick and Place)		Nos.		
	LT Panel (For Inverter)				
AC Package	LT Panel	9 MCCBs,800V, 320A, 3P MCCB, MP based WITH LSI PROTECTION (Input side) 2 MCCBs,800V, 32A, 3P MCCB WITH LSI PROTECTION + 800V,2500A, 50kA ACB with LSIG,UV & OV Protection, 2500/5 A,0.5s CT , 800/230 PT & 1.5 KVA Control Transformer with MFM class 0.5 IP55 Enclosure	Nos.		
AC Package	LT Panel	9 MCCBs,800V, 320A, 3P MCCB, MP based WITH LSI PROTECTION (Input side) 1 MCCBs,800V, 32A, 3P MCCB WITH LSI PROTECTION + 800V,2500A, 50kA ACB with LSIG,UV & OV Protection, 2500/5 A,0.5s CT , 800/230 PT & 1.5 KVA Control Transformer with MFM class 0.5 IP55 Enclosure	Nos.		
	Transformers				
AC Package	Inverter Duty Transformer (CU. Winding)	4 MVA, 0.8/0.8/11KV, Yd11d11, %Z = 7,Total Loss 1.1% ONAN, OCTC with +/- 5% @ 2.5% steps	Nos.		
AC Package	Inverter Duty Transformer (CU. Winding)	2 MVA, 0.8/0.8/11KV, Yd11d11, %Z = 6,Total Loss 1.1% ONAN, OCTC with +/- 5% @ 2.5% steps	Nos.		
	MV Panels				
AC Package	11kV, ICOG Panel @ Solar Plant	11kV,1250A VCB, 25kA for 1 sec, IP 55	Nos.		
AC Package	11kV, HT Panel @ PS-03	5 in 1 Out,11kV,1250A VCB, 25kA for 1 sec, IP 55	Nos.		
AC Package	11kV, HT Panel @ Solar Plant	2 in 1 Out,11kV,1250A VCB, 25kA for 1 sec, IP 55	Nos.		
AC Package	11kV, HT Panel @ Primary S/S	1 in 1 Out,11kV,1250A VCB, 25kA for 1 sec, IP 55	Nos.		
	LT Panels (For Auxiliaries)				
AC Package	Auxiliary transformer cum ACDB panel for ICR (Indoor Type)	10kVA, Dry Type, H Insulation Class,3 Phase - 0.8/0.415 V ,Dyn11	Nos.		
AC Package	Auxiliary transformer cum ACDB panel for MCR (Indoor Type)	30kVA, Dry Type, H Insulation Class,3 Phase - 0.8/0.415 V ,Dyn11	Nos.		
AC Package	Auxiliary transformer cum ACDB panel for PS-03 (Indoor Type)	15kVA, Dry Type, H Insulation Class,3 Phase - 0.8/0.415 V ,Dyn11	Nos.		
AC Package	Auxiliary transformer cum ACDB panel for MCR (Indoor Type)	25kVA, Dry Type, H Insulation Class,3 Phase - 0.8/0.415 V ,Dyn11	Nos.		
	UPS & Battery Bank				
AC Package	UPS - AC + DB for Inverter Yard	I/P :- 415 Vac, 3 phase O/P :- 230 Vac, 1 phase 5 KVA with 30 min back up (SMF VRLA Battery), 12V, 75 Ah - 24 nos.	Nos.		
AC Package	UPS-AC + DB for MCR	I/P :- 415 Vac, 3 phase O/P :- 415 Vac, 3 phase 10 KVA with 2 hrs. back up (SMF VRLA Battery), 12V,	Nos.		
	DC/LV/MV Cables				
DC Package	Solar Cable (PV Module to Inverter)	6 sqmm ,1.8kV Solar Cable as per EN -50618	Meters		
AC Package	Inverter to LT panel	1.9/3.3kV,3CX240 sqmm CU Armoured XLPE Cable	Meters		
AC Package	LT panel to IDT	1.9/3.3kV,1CX300 sqmm CU Armoured XLPE Cable	Meters		
AC Package	IDT to ICOG	11kV,3CX300 sqmm CU Armoured XLPE Cable	Meters		
AC Package	ICOG to 11kV Main HT Panel	11kV,3CX300 sqmm CU Armoured XLPE Cable	Meters		
	11kV Main HT Panel to Primary S/S - 2 Run	11kV,3CX400 sqmm CU Armoured XLPE Cable	Meters		
	Auxiliary Supply Cables				
AC Package	1.1kV Aux Cable		MWp		
	Control Cables				
AC Package	Control Cables		MWp		
	Communication Cables				
AC Package	Modbus RS 485 Cable	2CX2 PairX0.5 sqmm, RS485 Cable	MWp		
AC Package	OFC Cable	Optical Fiber Cable	MWp		
	Connectors & Jointing				
DC Package	MC4 connectors (For string side only)	1.8kV,30 A Rated , +ve & -ve connectors	Pair		
AC Package	CU Lugs for termination of cable	for 3CX240 Sqmm 1.9/3.3kV CU Armoured Cable @Inverter End & ACDB Incomer	Nos.		
AC Package	CU Lugs for termination of cable	for 1CX300 Sqmm 1.9/3.3kV CU Armoured Cable @ACDB Outgoing & IDT Incomer	Nos.		
AC Package	CU Lugs for termination of cable	for 1CX300 Sqmm 11kV CU Armoured Cable @IDT Outgoing & 11kV ICOG Panel Incomer	Nos.		
AC Package	CU Lugs for termination of cable	for 1CX300 Sqmm 11kV CU Armoured Cable @ 11kV ICOG Panel Outgoing & Main HT Panel Incomer	Nos.		
AC Package	CU Lugs for termination of cable	for 1CX300 Sqmm 11kV CU Armoured Cable @ Main HT Panel Incomer Outgoing & PS-03 Busbar Termination	Nos.		

Tentative Bill of Quantities		Location		Muscat	Salalah
		DC Capacity in Wp			
Packages	Material	Material Technical Description	Unit	Quantity	Quantity
AC Package	Double compression metallic gland	for 3CX300Sqmm 11kV CU Armoured Cable	Nos.		
AC Package	Cable accessories	Cable Tags, Cable Ties	LS/MWp		
AC Package	HT Cable Termination kit - Indoor Type	11kV, 3C X 300 Sqmm CU Cable	Nos.		
AC Package	HT Cable Termination kit - Indoor Type	11kV, 3C X 400 Sqmm CU Cable	Nos.		
AC Package	CU Lugs for termination of cable	for 1CX400 Sqmm 11kV CU Armoured Cable @ 11kV 2 in 1 Out Panel Outgoing & Main HT	Nos.		
AC Package	CU Lugs for termination of cable	for 1CX400 Sqmm 11kV CU Armoured Cable @ Main HT Panel Incomer Outgoing & PS-03	Nos.		
AC Package	Double compression metallic gland	for 3CX400Sqmm 11kV CU Armoured Cable	Nos.		
	Other accessories				
AC Package	Cable ties	300mm Long UV Protected (100Nos in Each Packet)	Packets		
DC Package	Black DWC HDPE conduits (for solar cable) & its accessories	50mm OD DWC Conduit	Meters		
AC Package	HDG Cable Tray for ACDB Panel to Transformer	300 mm wide Ladder type Cable Tray (min. 80 microns)	Meters		
AC Package	Air conditioning in main control room	2 Ton, Split AC	Nos.		
AC Package	Exhaust fans in ICR & MCR	Exhaust fans, 1.5 hp	Nos.		
AC Package	Street Light for Periphery	30W LED light, Pole at 25 mtrs gap with 3 mtrs high, average 5 lux	Nos.		
AC Package	LED lights on building (Outdoor)	30W Outdoor LED light fixture & Poles (If required)	Nos.		
AC Package	40W at security cabin	40W LED light	Nos.		
AC Package	40W LED in ICR	LED tube 2 X 20W	Nos.		
AC Package	40W LED in MCR	LED tube 2 X 20W	Nos.		
AC Package	25W LED in MCR	LED fixtures 25W with industrial wall mounted bracket	Nos.		
AC Package	15W LED fixture in MCR	LED fixtures 15W with Downlights	Nos.		
AC Package	Small Lightning DBs in IR	Switchboards (6 PS with switch and socket)	Nos.		
AC Package	Small Lightning DBs in MCR	Switchboards (2PS, 4PS and 6 PS with switch and socket)	Nos.		
	Weather Monitoring System				
SCADA	Pyranometer (at POA) with tilt disk	SMP 3	Nos.		
SCADA	Pyranometer (at GHI) without tilt disk	SMP 3	Nos.		
SCADA	Solar Radiation Sensor Mount Kit	Tilting Kit	Nos.		
SCADA	Ambient temperature		Nos.		
SCADA	Module temperature sensor		Nos.		
SCADA	Humidity sensor with weather seal		Nos.		
SCADA	Rain Fall sensor		Nos.		
SCADA	Anemometer (Wind Speed + Wind Direction)		Nos.		
SCADA	Barometric Pressure Sensor		Nos.		
SCADA	Soiling Station		Nos.		
SCADA	Power Supply		Nos.		
SCADA	Datalogger		Nos.		
SCADA	Enclosure for Datalogger (IP65)		Nos.		
SCADA	3 mtr tripod for mounting of sensors		Nos.		
	SCADA System				
SCADA	ICR	ICR RTU - RS 485/OFC Communication ports, PLC, auxiliary, DO, AI AO ports, relays, industrial grade switch, rack and enclosure	Nos.		
SCADA	MCR	MCR RTU - RS 485/OFC Communication ports, PLC, auxiliary, DO, AI AO ports, relays, industrial grade switch, rack and enclosure	Nos.		
SCADA	Network & switch rack accessories cost	Network and switch racks	Nos.		
SCADA	Software	i. Engineering license for Logic & SCADA Development, ii 2 Nos. SCADA Runtime license, iii SCADA Remote Web Browser viewing license - 3 Users,	Nos.		
SCADA	Other hardware	As required	Nos.		
SCADA	PPC equipment & study	Power plant controller for Zero Export at 132kV Grid & its logic development	Nos.		
	Fire Detection & Alarm System				
AC Package	Multi detectors	Multi detectors	Nos.		
AC Package	Heat Detector	Heat Detector	Nos.		
AC Package	Smoke Detector	Smoke Detector	Nos.		
AC Package	Manual Call Points	Manual Call Points	Nos.		
AC Package	Fire alarm Panels - 2 zone Microprocessor based conventional type	Fire alarm Panels - 2 zone Microprocessor based conventional type	Nos.		
AC Package	Hooters	Hooters	Nos.		
AC Package	Cables	2C,1.5sq.mm, armoured, FRLS, Cu. PVC insulated cable	Meters		
	Fire Fighting Equipment				
AC Package	CO2 fire extinguishers - 6 kg - at each block control room and one main control room	CO2 fire extinguishers - 6 kg - at each block control room and one main control room	Nos.		
AC Package	Fire Bucket @ Trafo yard	Buckets with sand and stand (3 sand bucket with 9 litre capacity)	Nos.		
AC Package	First Aid Box @ ICR & MCR	B Type	Nos.		
	CCTV				
SCADA	Cameras @ IR + Trafo Yard	IP Metal Bullet camera (Suitable for Outdoor duty -IP66) with 20m IR coverage range & Day night vision	Nos.		
SCADA	Cameras @ MCR	Dome camera (Suitable for Outdoor duty -IP66) with 20m IR coverage range & Day night vision.	Nos.		
SCADA	Cameras @ Main Gate	Bullet camera (Suitable for Outdoor duty - IP66) with 20m IR coverage range & Day night vision	Nos.		

Tentative Bill of Quantities		Location		Muscat	Salalah
		DC Capacity in Wp			
Packages	Material	Material Technical Description	Unit	Quantity	Quantity
SCADA	Accessories	8 Channel NVR (Up to 4MP supported) with 15 Days 24X7 Storage facility with 2TB Surveillance HDD at MCR. Wi-Fi receivers	Nos.		
SCADA	Accessories	8 channel gigabit media converter for connect all camera output & connect to network switch Via cat-6 cable (where distance between camera & switch is more than 90 mtr)	Nos.		
SCADA	CCTV Monitor	32" LED Color Monitor for CCTV monitoring	Nos.		
SCADA	Power Cable	Auxiliary Power supply cable for POE (media converter) - 2C, 1.5sq.mm, armoured, FRLS, Cu. PVC insulated cable	Meters		
	Lightning Arrestor				
DC Package	ESE Type Lightning Arrestor	ESE type	Nos.		
	Earthing				
DC Package	For DC Yard & LA	17.2mm Dia, 3 meter Long, CU Bonded Rod (min. 290 Microns) + 50kW Backfill Compound + Earthing Chamber	Nos.		
AC Package	For ICR +ICR cum MCR	17.2mm Dia, 3 meter Long, CU Bonded Rod (min. 290 Microns) + 50kW Backfill Compound + Earthing Chamber	Nos.		
AC Package	For Street Lights	17.2mm Dia, 1 meter Long, CU Bonded Rod (min. 290 Microns) + 25kW Backfill Compound + Earthing Chamber	Nos.		
AC Package	SPD earthing of Com100& LT panels	17.2mm Dia, 3 meter Long, CU Bonded Rod (min. 290 Microns) + 50kW Backfill Compound + Earthing Chamber	Meters		
AC Package	Inverter earthing cable	1C X 95 sqmm, PVC CU Cable (Green Colour)	Meters		
AC Package	DC AC Earthing cable	1C X 16 sqmm, PVC CU Cable (Green Colour)	Meters		
AC Package	AC Earthing cable	1C X 240 sqmm, PVC CU Cable (Green Colour)	Meters		
DC Package	Down Conductor for LA	70 Sqmm CU PVC Earthing Cable	Meters		
AC Package	Top cover for Earth Pits		Nos.		
	Cable Trenches & Civil Infra				
Civil & Infra	Pile Pull Out & Other test	1 bore hole of 5 mtrs to be carried out/12.5 Acre acres of land parcel. Trial Pit to be carried	Set		
Civil & Infra	Land Development		Acre		
Civil & Infra	Peripheral Road	WBM Road	RMT		
Civil & Infra	Internal & Approach Road	Concrete Roads	RMT		
Civil & Infra	Inverter Transformer Yard Fence	1.8mtrs high G.I. chain link fencing with toe wall, foundation and gates	RMT		
Civil & Infra	Main gate	RCC columns with Mild sheet leafs with tubes and columns. Width of 4.5 mtrs, with two leafs	Nos.		
Civil & Infra	Security Cabin	2.5 X 2.5 meter Prefabricated structure	Nos.		
Civil & Infra	Watchtower	4.5mtrs high from NGL.	No.s		
Civil & Infra	Main control room	Main Control Room	sq.ft.		
Civil & Infra	Foundation of LT panels	Foundation (M25) - 5x1m	Nos.		
Civil & Infra	foundations for ICOG panels	Foundation (M25) - 2.5x1m	Nos.		
Civil & Infra	foundations for IDT	Foundation (M25) - 2 x 1.5m block foundation with 4 x 4m sump pit	Nos.		
Civil & Infra	Inverter mounting stand	Set of 2 nos of Column post C sections of 50x50x2.15mm thick & its foundation	Nos.		
Civil & Infra	LA foundation	Foundation (M25)	Nos.		
Civil & Infra	WMS foundation	Foundation (M25)	Nos.		
Civil & Infra	Peripheral Street Light Foundation	Foundation (M25)	Nos.		
Civil & Infra	Transformer Yard Lights	Foundation (M25)	Nos.		
Civil & Infra	foundations for Main 11kV HT Panel	Foundation (M25)	Nos.		
Civil & Infra	Additional Item 1	Bidder to provide description			
Civil & Infra	Additional Item 2	Bidder to provide description			
Civil & Infra	Additional Item 3	Bidder to provide description			
Civil & Infra	Additional Item 4	Bidder to provide description			
Civil & Infra	Additional Item 5	Bidder to provide description			
Civil & Infra	Additional Item 6	Bidder to provide description			
Civil & Infra	Additional Item 7	Bidder to provide description			
Civil & Infra	Additional Item 8	Bidder to provide description			
Civil & Infra	Additional Item 9	Bidder to provide description			
Civil & Infra	Additional Item 10	Bidder to provide description			
	Electrical Contractor				
DC Package	DC Work	Installation, Testing & Commissioning	MWp		
AC Package	AC Work	Installation, Testing & Commissioning	MW		
	Internal Management				
Misc	Engineering	Detail engineering cost	LS		
PMC	Project Management	Project management + Quality cost	LS		
Transportation	Logistics/Storage	Logistic/Storage	LS		
Insurance	Insurance	Asset and Construction All Risk (including free issue items if any)	LS		
	Approvals				
Approvals	Government approval	Liasioning approval	MW		
	Studies				
Civil & Infra	Topography survey	Topographical survey, mapping, contouring and documents - total station	Acre		
Civil & Infra	Flood Risk Assessment & Hydrological study	Flood Risk Assessment & Hydrological study	Lot		
Civil & Infra	Soil Test & ERT		Nos.		
AC Package	Load Flow analysis	Power factor control assessment,	Nos.		
AC Package	RE Control Operation Study	OETC Requirement	Nos.		
AC Package	Healthy State (N) Voltage Profile	OETC Requirement	Nos.		

Tentative Bill of Quantities		Location		Muscat	Salalah
		DC Capacity in Wp			
Packages	Material	Material Technical Description	Unit	Quantity	Quantity
AC Package	Power Flow intermittency analysis	Largest Solar Variation	Nos.		
AC Package	Contingency Analysis	Worst Case Scenario (Max and Min)	Nos.		
AC Package	Short Ckt. Analysis	OETC Requirement	Nos.		
AC Package	Transient Stability Analysis	Voltage Stability Criteria Damping Criteria 3Ph. Bus Fault Single Ph. Bus Fault N-1 Contingencies Loss of the largest demand in Generation	Nos.		
AC Package	Fault Ride Through	OETC Requirement	Nos.		
AC Package	Frequency Response Study	OETC Requirement	Nos.		
AC Package	Reactive Power Response	OETC Requirement	Nos.		
AC Package	Power Quality Study	Voltage Unbalance Flicker Study Frequency Scan and harmonic distortion (HD)	Nos.		
AC Package	Connection Assessment Study	OETC Requirement	Nos.		
Electrical Package	Additional Item 1	Bidder to provide description			
Electrical Package	Additional Item 2	Bidder to provide description			
Electrical Package	Additional Item 3	Bidder to provide description			
Electrical Package	Additional Item 4	Bidder to provide description			
Electrical Package	Additional Item 5	Bidder to provide description			
Electrical Package	Additional Item 6	Bidder to provide description			
Electrical Package	Additional Item 7	Bidder to provide description			
Electrical Package	Additional Item 8	Bidder to provide description			
Electrical Package	Additional Item 9	Bidder to provide description			
Electrical Package	Additional Item 10	Bidder to provide description			